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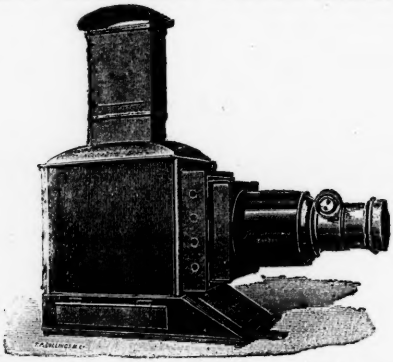

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I.

THE

JOURNAL OF SCIENCE.

NOVEMBER, 1880.

I. THE DUKE OF ARGYLL "ON THE UNITY OF NATURE."

By J. FOULERTON, M.D.

IN an article by the Duke of Argyll, in the "Contemporary Review" for September, 1880, the author explains what is meant by the Unity of Nature by examples drawn from natural phenomena, and gives certain speculative opinions with regard to its belief in very early times, and its relation to Monotheism.

The examples drawn from natural phenomena, though containing nothing that is actually new, are very forcibly put, but I can only give a very brief statement of them here, just sufficient to show the line he adopts.

First of all he refers to gravitation as a mysterious force linking the whole universe together, and not only keeping the heavenly bodies in their places, but intimately connected with our very existence and the due performance of vital functions.

He then considers that highly elastic body pervading space, the medium of light and heat, electricity and chemical action, and how the various wave-motions which constitute these all move with immense velocity through the ether without jostling or confusion, like the harmonious vibrations of sound in the atmosphere.

He also refers to the nature of Life, which he cannot regard, as some do, as simply a physical condition and property of protoplasm, but rather of the nature of a force or energy working on protoplasm, and that there is a unity in

this force which makes one piece of protoplasm develop into a tree, whilst another not distinguishable from it may develop into a man.

Thus we see that the author has been dealing with some of the latest acquisitions of natural science to exemplify the Unity of Nature, which he defines as "that intricate dependence of all things upon each other which makes them appear to be parts of one system," and adds "that it may well be that the sense of Unity in Nature, which man has had from very early times reflected in such words as the 'Universe,' and in his belief in one God, is a higher and fuller perception of the truth than is commonly attained by those who are engrossed by the laborious investigation of details," and considers that "this is one of the many cases in which the intuitions of the mind have preceded inquiry and gone in advance of Science, leaving nothing for systematic investigation to do, except to confirm by formal proofs that which has been already long felt and known."

My object will be to endeavour to show, first, that the Unity of Nature and Monotheism have never been generally believed by mankind; and, secondly, that, though the evidence given by the author does not prove the Unity of Nature, however probable it may make it, and though everything he says about gravitation, ether, light, heat, electricity, life, &c., may be wrong,—we may reasonably presume some of it is,—the Unity of Nature would still be true, and that there is evidence which cannot be negatived, and which no errors in detail can in any way affect.

First, as regards the evidence given by the author of the general belief by mankind in the Unity of Nature from the use of the word "Universe." I do not see how this can prove it. The words "Universe" and "Unity," though very near each other in the Dictionary, have quite different meanings. One might say of the Laws of the Universe that they acted inharmoniously and in antagonism to one another, which is just the opposite of what is meant by the Unity of Nature.

This is not the place to discuss the "intuitions of the mind," or what may be called, except in metaphysical language, inherited ideas; but such ideas or feelings always relate to actions of vital importance to the species, and which have so long been performed by them that they have at length become organised—such, for instance, as those prompted by hunger, or the care of the young. But to what actions of vital importance to the human species could ideas of the Unity of Nature lead; a million years hence, perhaps, they

may, if competitive examinations last so long, and if so they will become organised and take their place among the "intuitions of the mind."

From what the author has said, in the passage quoted above, one would suppose that general beliefs on abstruse natural phenomena were frequently correct, and that all Science had to do was to interpret the inspiration and set its seal upon it. Now I think it would not be too much to say that there never yet was a natural phenomenon, not being about as obvious as that the sun is a source of light and heat, that vinegar is sour to the taste, or that a blow is painful,—that is to say, which did not directly impress itself upon the senses,—that was not misinterpreted by general beliefs. A step or two in the process of deduction and general beliefs are a chaos of errors. Indeed if one wants to know for certain what is wrong with regard to any question which is not immediately patent to the senses, he has only to find out what the popular belief is or was. I will give one or two illustrations:—There were two ways at least of accounting for the apparent movement of the heavens round the earth, one of them being that the heavens actually did move and that the earth was still; so this erroneous theory was adopted, and the correct one when discovered was rejected, on account of the supposed great importance, morally, of the earth and man; so that not only was a wrong theory accepted, but the right one was rejected for a wholly irrelevant and personal motive—a very common line of argument, as we shall presently see.—Except in the case of direct physical injuries, all pain and disease were accounted for by witchcraft and similar agencies, by which also many other natural phenomena were accounted; and we all know the erroneous beliefs of mankind with regard to the nature and effects of comets, eclipses, meteors, &c.—Illustrations could also be given from religion and politics, but as these are still in the region of popular beliefs there would be too much difference of opinion for them to have any force. There are, however, two facts which may be said to have reached scientific precision which will forcibly illustrate the wrongheadedness of popular beliefs; one is the advantages of free trade over fettered trade, the other is the advantages of tolerance of opinion over intolerance; yet how many ages have passed and how much misery had to be endured, through the action of the wrong theory, before the right one made any impression on popular beliefs. In speaking of popular beliefs it must not be supposed that I am alluding to the populace, or lower classes, as distinguished from their so-called betters.

The errors of popular beliefs affected Popes and Kaisers just as much as they did the lowliest of their subjects; indeed if they had not, they would not have been Popes or Kaisers at all. So persistently, indeed, are popular beliefs wrong, even in matters intimately affecting the welfare of mankind, whenever it is necessary to take a step or two in the process of deduction, that if they were right —as the author thinks—with regard to the Unity of Nature, it would be a very extraordinary exception to the rule.

But besides all this, which may be called probable evidence, we have abundant positive evidence that the general belief of mankind has been, and still is, not in a unity, but in a duality of nature and supernatural beings.

In the same way as the author has stated some of the most recent scientific views as evidences of Unity of Nature, let us take a very brief survey of some of the principal beliefs with regard to the Universe which have been, and many of which are still entertained even by civilised nations as evidence rather of a belief in its duality, viz., that this world, though only a flat surface a few miles in area, bounded by the horizon, was the largest portion of the universe; that the sun, moon, and stars were mere appendages quite close to the earth, for the benefit of man—the central figure of the universe, and on whose account it was all brought into existence in a week; that in this world, which was practically the universe, it was the earnest wish of its Maker that there should be no pain or death, no sin or misery, but perpetual health and life, morality and happiness; that from the very beginning another personage appeared upon the scene with views totally antagonistic to those of its Maker, viz., that there should be disease and death, sin and misery; that these two powers have been in a perpetual struggle ever since, and that so far the evil power has been much the more successful of the two; that, during the struggle, miracles—breaks in the uniformity of Nature—are continually being performed by both parties, and are looked upon very much as are the stratagems of ordinary warfare; that prayers offered up to the beneficent power—in some communities they are offered up to the evil power, in order to propitiate him, the beneficent power being supposed not to need them—may at any time alter what would otherwise be the course of Nature; that thus the dead have been restored to life, the sick made well, the earth more fruitful; that wind or calm, sunshine or shadow, rain or drought, health and prosperity of ourselves and our friends, or death and

confusion of our enemies, have all been obtained through their means, and contrary to what would have happened but for our prayers. But every such event is in fact a miracle,—a breach in the uniformity of Nature's law. This is a bare statement of facts which will be admitted by all, whatever may be their views otherwise with regard to prayer—a subject which does not concern us here.

No people are supposed to have been more firm in their monotheistic belief than the Jews, yet their whole lives were spent in such an atmosphere of miracles as it would hardly be possible for us now to realise.

It could easily be shown that ancient Pagans and modern Savages, just like ourselves, have regarded the universe solely from a personal point of view, and in a dualistic sense as it affected their joys or sorrows, without any thought whatever of a great law of uniformity.

If, notwithstanding such general beliefs with regard to the system of the universe, wholly erroneous as we now know them to be, without any knowledge whatever of those generalisations we call laws of Nature, such as are given by the author as evidence of its unity, and believing, moreover, that the ordinary course of Nature was continually being set aside, at one time by its Author, at another by his opponent, mankind still believed in the Unity of Nature, it would be a most marvellous and unaccountable circumstance, and would require much stronger evidence in support of it than merely calling it an "intuition of the mind,"—a most convenient psychological Cave of Adullam for the reception of all real or supposed mental phenomena which will not fit in anywhere else.

Theology is in the habit of twitting Science by saying "You admit there was a beginning to the universe; that of itself is a miracle; but if you believe in one, why not in others." Science knows nothing of the matter, and postulates nothing. Theology dogmatically affirms that the universe will have no end; suppose Science were to affirm, equally dogmatically, that it had no beginning? The one assertion is just as incomprehensible and unprovable as the other; but the modesty of Science is shown in admitting its ignorance, and its honesty and love of truth in not predicating anything under the circumstances.

The great mistake made by the author, as by many others, is in supposing that Theology has anything to gain from Science, or Science from Theology. Abraham was a sound theologian, with no more knowledge of Science than any other Bedouin of the Desert; and there have been

many able men of Science whose Theology was, as the author remarks, weak. Theology and Science would thus seem to be in inverse proportion to one another, and the reason of this is to be found, I believe, in the erroneous relationship in which they are supposed to stand to one another. Theology anathematises Science because it is not theological, and Science returns the compliment because Theology is not scientific; whilst there are those who, like the author, bless them both, and would make out that they are indispensable to one another. Perhaps some day it will be discovered that, on the contrary, they are entirely independent of one another. There are no doubt many things included under Theology, and generally considered the most important part of it, which have no more right to be so than paint and feathers to be called man, though they too are often considered the most important part of him. An enlightened common sense may be trusted to make the necessary distinction.

Attempts are now frequently made to prove that miracles are not breaks in the uniformity of Nature's laws, just as they are made to show that seven days are countless ages, and it is a hopeful sign to see this growing tribute to great truths; but for the present their success does not concern us, but only this—that no one thought of such a question formerly, there being no idea of any such uniformity any more than there was of the countless ages.

The author makes the following remark, which seems somewhat singular from so firm a believer in the Unity of Nature:—"A sense and a perception of the Unity of Nature—strong, imaginative, and almost mystic in its character—is now prevalent among men over whom the idea of a personal agency of a living God has, to say the least, a much weaker hold." Why does he call a sense of the Unity of Nature imaginative and mystic? It can hardly be because he has any doubt about it. The fact is that, like many others, he seems to shrink from what he believes to be its logical consequences on religious faith; but nobody need trouble himself in the least about that: man's faith has never yet been comprised within the three corners of a syllogism, whether they contained the Unity of Nature or anything else.

The second object I propose to attempt is to show that,—though everything the author says about gravitation, light, heat, electricity, life, &c., may be wrong, without in the least affecting the truth of the Unity of Nature,—there is such evidence of its truth as cannot be

refuted, and which no errors in detail can in the least affect.

The position of any planetary body in space, at any given moment, is the resultant of all the forces of gravitation that have acted on it. So, likewise, of all the planetary bodies.

Any particular organism—plant or animal—is the offspring and resultant of all the varying conditions of all its ancestors. So, likewise, all the organisms living at any particular time are the resultant of all those that have preceded them, and from which they have descended.

The present geographical and geological configuration and structure of the earth are the outcome of all those that have gone before, by an uninterrupted succession of gradual changes.

Thus, whilst the present position of the planetary bodies, the present organisms that inhabit the earth, and its present geographical and geological features may be very different from what they were millions of years ago, the great change was brought about by a succession of small ones,—each, indeed, so small as to be wholly inappreciable, the one condition gradually shading into the other. There is thus a continuity, unity, or what may be called an individuality, pervading each, similar to that which unites the old man to the child, but without anything to indicate either youth or old age. But if this be so with each separate thing, or system of things, it will also happen with everything and all systems; in other words, the condition of the whole universe at any particular moment will be the outcome or resultant of all previous conditions, and, however much it may differ to-day from what it was at any former period, a thread of continuity or unity will run through the whole. We talk very glibly of the beginning of the world, and think we have then got to the beginning of the universe; but to say nothing of the enormous antiquity of this world itself, compared to which the whole geological record from the earliest stratified rocks to the present day is probably a mere vanishing point, we would practically be no nearer the beginning of the universe, even if we could arrive at the commencement of this infinitesimal portion of it, counting from the time when it may be said to have had a separate individuality; for who shall tell the previous history of its component parts, and into the structure of how many worlds they may not formerly have entered? Science knows nothing of beginnings or endings in an absolute sense, whilst relatively it knows of nothing else, each following the other

in unceasing succession. But as the total amount of matter in the universe is always the same, and as its condition at any particular moment is the resultant, the outcome, the effect of the previous condition, it follows that the effect contains the whole of the cause, neither more nor less. Take an example on a smaller scale. Oxygen, hydrogen, and motion are not only the cause, so to speak, of water; they are water. Cause and effect are therefore merely different aspects of one and the same thing. The universe of to-day is therefore one and the same with that of any previous time, however different may be the arrangement of its constituent parts, and the reason of this is neither more nor less mysterious than is the reason of the infinite succession of causes and effects which are going on every moment within us and around us.

I will briefly sum up thus:—1st. There is no evidence of a general belief in the Unity of Nature and Monotheism; the probabilities are all against it; and there is abundant evidence of a belief in a dualism both of Nature and of supernatural beings. 2nd. As the sum of all effects is = the sum of all causes, the universe of to-day is = the universe of any previous time, and this it is which constitutes the Unity of Nature. In order to disprove it, the sum of an effect must be shown to be either greater or less than the sum of its cause, which is impossible.

The above was written before the issue of the October number of the "Contemporary Review," in which there is a second article on the Unity of Nature, by the Duke of Argyll, which I think fully bears out my remarks regarding the faulty nature of the method he has adopted as evidence of it; for if what he now states be true, it would show not a unity but a duality of Nature.

The first article was mainly occupied with the phenomena of non-living matter—with the movements we call heat, light, electricity, chemical action, &c., and the intimate relations existing between them; the present one treats of the phenomena of life, and shows their close relationship in all living things from the amœba up to man. This is no doubt all quite true; but of what use is it as evidence of the Unity of Nature, if, as he now says, there is a great gulf of difference, even of antagonism, between the living and the non-living. A chain is no stronger than its weakest link; and if the Unity of Nature can withstand one such antagonism, why not any number of them? Thus heat, light, electricity, and chemical action

might have no sort of affinity with each other, on the one hand; or organisms on the other, without in the least affecting the evidence.

In the same number of the "Contemporary" there is also an article by the Hon. Justice Fry advocating similar opinions, and, consistently enough from this point of view, deprecating "that simplicity or unity which partly entices men to adopt the purely materialistic theory of things." With that *bête noire*—the materialistic theory—we have nothing to do. All I wish to call attention to is the fact that the Hon. Justice Fry finds that a gulf of difference between the living and the non-living is opposed to the theory of unity.

But after all may not this gulf of difference be only one of ignorance? Until quite recently birds and reptiles were supposed to be isolated by impassable gulfs, and this was considered by many to be a strong argument against organic evolution, or what may be called the Unity of Organisms. These gulfs have now been bridged over.—At one time the earth was too hot for any living organism; but when it cooled down sufficiently to allow of these, is it not quite possible that they may have been formed out of non-living matter, and if so what would become of the antagonism between them? There are some who think that this process of conversion of non-living into living matter has been going on ever since and is going on still; but whether that be so or not does not much affect the argument, for the conditions of heat, moisture, atmospheric composition, &c., which may have existed when organisms first made their appearance, may not be possible now. If the Unity of Nature be true, as most assuredly it is, then all the phenomena of Nature must hang upon one another, and, having got hold of a fundamental, all-embracing fact, which is none the less true because the knowledge of it is of recent growth, we must not mar its symmetry and beauty either through our ignorance or for the sake of any barren speculations about Materialism.

II. ON HEAT AND LIGHT.

By ROBERT WARD.

ACCORDING to the modern scientific idea Heat is a "mode of motion." Prof. Tyndall, who has done so much towards popularising this view of heat, describes it as "an accident or condition of matter; namely, *a motion of its ultimate particles*." He discards the material theory which supposes heat to be "a kind of matter—a subtile fluid stored up in the inter-atomic spaces of bodies." Yet for a long time the latter had the greater number of supporters eminent in Science.

It is not my intention to suggest that either the one or the other theory is devoid of truth. I have elsewhere shown that all things exist by virtue of their circumstances, and that, as the circumstances of all things are continually changing, all things must be continually changing (*see* "Constitution of the Earth," p. 4). That such change is always going on is rendered obvious by the amazing fact that everything *grows older*. Even wine, however preserved from contact with surrounding objects by being hermetically sealed in a glass bottle, undergoes a change well known to the toper, though undiscoverable by the analytical processes of the chemist. That this change is a never-ceasing one is as evident as that a body falling from an elevated position must pass through all the intermediate points of space before it reaches the ground. There may be no evidence of any substantive addition to, or withdrawal from, the contents of the bottle; nevertheless the wine *has grown older*, as discoverable by the sense of taste, and by such change, up to a certain point, it is humanly speaking "improved." It cannot be doubted that, from the time a human being comes into the world till he passes out of it, the entire phenomena of life consists of an unceasing change. Infancy, youth, manhood, and old age are only terms by which we recognise the more prominent phases of a never-ending, still-beginning evolution. To indicate their appreciation of such change, chemists formerly told us that in seven years every molecule of the original substance of the human body had been removed and substituted by other molecules. The more modern idea is that this takes place at much shorter intervals; but is it not obvious that a human being is never for a single

moment exactly what he was the moment which immediately preceded?

Now what is change but motion? And yet it is *more* than motion: however imperceptible it may be, it is part of the process of *transformation* by which the wine is improved, and by which the child becomes a man. The effect is not a mere mechanical rearrangement of parts,—not only a "vibration" or "clashing of atoms,"—but a constitutional or radical difference, however small, between the original and present states. Either "something" has been taken or something has been added; and is it not probable that something has been both taken and added, by which the change has been produced? We may call that something "matter," or we may call it "an accident or condition of matter:" the change could not have taken place without motion, but *neither could it have been produced by motion alone.*

In the volume to which I have referred I have shown that, on the assumption that all things exist by virtue of their circumstances, it follows that "a change in the circumstances of things necessarily involves a corresponding change in the things themselves." This I have described as "the Law of Motion." Hence it is that—as Nature is never at rest, as worlds and systems of worlds are always moving, and as all the other bodies of space, small or great, are perpetually taking up new positions in relation to each other—every bit of matter in the universe, every atom or molecule, is perpetually undergoing a process of change. May we not assume that heat is one of the forms of this change? It is undoubtedly true that, according to the extent or degree of this change, we must have motion; and according as this motion in extent or degree appeals to our sense of feeling, by adding to or subtracting from the natural warmth of our bodies, we employ the terms heat or cold to express our estimate of the character of the phenomenon.

The truth is that all things in Nature are united together by a constitutional relationship, of which the action of heat upon our organism is one of the manifestations. We become mentally acquainted with this relationship by means of the senses of seeing, feeling, hearing, tasting, &c. When I look round the room in which I am sitting, I see articles of various forms, sizes, and colours,—*e.g.*, chairs, tables, pictures, &c. Why do I see them? I may be told that it is because rays of light are reflected from the objects to my organs of vision; and it is true that without light I could

not see them. But neither could I see them without eyes; and yet it is evident that, whether I see them or not,—whether my eyes are open or shut,—the relationship between the objects and my organism, *so far as it is mechanical*, must always be the same as long as they and I remain unmoved. The objects, in fact, exist independent of either the light or my eyes, but the actual perception of them is due to certain qualities which are impressed upon my organism when the necessary relationship is established. Thus there are three factors necessary to sight—eyes, objects, and light. The qualities by which objects are revealed to us are colour, form, and size. Really, however, so far as the visual perception of things is concerned, colour is the basis or foundation of sight, form and size being due to a perception of differences in colour, and to the limitation or extension of such differences. Thus I can only see the chairs, tables, pictures, &c., by virtue of the light which strikes upon their surfaces and reveals to me various colours, or shades of colour, the perception of which (by contrast) is the foundation of my knowledge.

As in the case of heat, Light was believed by Newton to be due to the emission of a subtile fluid, but modern Science repudiates the teaching of the great philosopher as to both light and heat, and they are now severally described as simple "modes of motion." Heat, we are told, is a clashing together of the ultimate particles of matter; whilst Light is due to the vibrations of a luminous ether wholly unknown to the senses, but which fills all space and penetrates between the molecules of all bodies. White light, as it reaches us from the sun, is a compound or mixture of many colours. The different colours of bodies are said to be due to the way they reflect the different kinds of light, by creating in the imaginary ether waves of different lengths. These waves, though as infinitely numerous as the shades of colour, are supposed to move simultaneously and perfectly distinct, so that each will produce its own separate and characteristic effect upon the organs of vision.

Such is the modern scientific theory as to the creation of colours. I must confess that my understanding is not so much enlightened by it as by the emission theory of Newton. The solar spectrum exhibits seven principal colours, but these imperceptibly merge into each other through an infinity of intermediate tints. I find it hard to imagine seven waves of different lengths, all moving with equal speed and striking the retina of the eye at the same moment; but I am totally unable to realise the idea of an *infinity* of different

lengths of waves—representing the infinity of intermediate tints—striking the retina in the manner described. If I must penetrate the mystery, I confess that it seems easier to comprehend the emission than the undulatory theory. I know that all things are growing older, and therefore undergoing an unceasing change, and I cannot understand how such change can take place without the emission of *something*. What is that something? It seems to me that it is the cause of all the changes perpetually taking place in Nature. It is by this emission (or by this absorption) that I become acquainted with the several qualities of things and their relationship to my own organism. Something is constantly passing between all bodies, by which they act and react upon each other; by which they are at once separated and united; by which all change—mechanical, chemical, and physiological—is produced, and which is at the same time the origin of life and the cause of decay. This something appeals to our senses in many phases—has heat or cold, as odours, as sounds, as colours differentiated into forms or sizes, as tastes, as the various impressions of touch or feeling, &c. This something, in its many forms and qualities, in its attractions and repulsions, and, in short, by the infinity of its phenomena, constitutes the *reality* of which gravity is the *abstract conception*. For, as Newton himself suggested, gravity is due not to "occult qualities supposed to result from the specific forms of things, but *as general laws of Nature by which the things themselves are formed; their truth appearing to us by their phenomena*, though their causes be not discovered."

Nor are the impressions of distant objects communicated through the senses of no physical account in building up the living organism. Such impressions fix themselves more or less permanently in the memory, and assist in creating the brain tissue by which memory itself is established. The brain may, in fact, be described as a storehouse of such impressions, in which are gathered not only the experience of the living individual, but of all his ancestors to the remotest conceivable beginning. And as is the brain, so is the body. The inconceivably attenuated matter (or something) which strikes upon our senses from surrounding objects may be said to have in it "the promise and potency of every form and quality of life."

Of all the impressions received from outward objects, those of heat and light are the most active in producing change. Heat is the moving agent in all manufacturing processes having for their object the speedy conversion or

transmutation of bodies, and heat and light are the most important elements in connection with all the phenomena of vital action. By their means, out of the same soil and air is evolved the tender bud, the green leaf, the woody fibre, every form and description of vegetation, every variety and tint of colour, every kind of odour, and numerous other qualities by which our several senses are either obnoxiously or agreeably influenced.

And yet it is said that light and heat can create nothing or destroy nothing; that they are mere modes of motion—the action of the "eternal and imperishable" parts of the huge machinery of the universe, which change only in their relation to each other and not in their constitution. If this meant that heat and light can, in the absolute sense, create or destroy nothing, no objection could reasonably be made. We know nothing of either matter or motion beyond the impressions which they communicate to our consciousness through the senses. The forces of nature may indeed be described as only the agents by which the Supreme Creator works out His purposes in the universe; but are we not, therefore, all the less justifiable, when we see these wonderful creations of light and heat, in denying that they are, what they appear to be, transmutations, in some degree, of the several materials or objects out of which they have been constituted? That is, a transmutation (not of abstract matter, which is only a metaphysical conception) of the several qualities by which the objects are presented to our consciousness, and by which alone they are known to us?

Whilst some scientists treat heat as only a mode of motion, an accident or condition of matter,—others constantly refer to it as an entity of absolute power. Hence we read of calulations to determine how much of the sun's heat is utilised in warming the planetary bodies, and how immensely more is wasted in space. I do not dispute that the sun, like everything else in Nature, is undergoing changes, or "growing older"; but let this be remembered, that heat, such as it is known to us on the earth, may be something very different at its source; that, in fact, there is no reason to believe that the sun is being burnt up like the coals upon our fires. On the contrary, there is much reason to believe the reverse. Only a few miles up in the air it is freezing cold; the light rays illuminate the regions above the clouds, but the heat rays *are absent!* Certainly no evidence this of immutable heat (or even of heat such as it is known to us by combustion) radiating from the sun into space. If we place a sheet of glass before the fire, the heat

rays are stopped till the glass itself becomes hot; or if we place a sheet of ice in the same position, the same result ensues till the ice is melted. On the assumption that the sun is throwing off heat like a fire, the thin air of the upper regions acts like a sheet of glass or ice with this remarkable difference, that the heat never raises the temperature of the air, and yet (apparently, at least) *it gets through it*, as known to our consciousness on the earth's surface! The heat gets through, but not as the heat known to our senses, for Rumford showed that calorific rays can be passed through a vacuum without losing their temperature in the passage. The question of the temperature of the sun has been the subject of investigation by many scientists. Newton, one of the first investigators of the problem, tried to determine it, and after him all the scientists who have been occupied with calorimetry have followed his example. All have believed themselves successful, and have formulated their results with great confidence. The following, in the chronological order of the publication of the results, are the temperatures (in centigrade degrees) found by each of them: Newton, 1,669,300°; Pouillet, 1,461°; Zöllner, 102,200°; Secchi, 5,344,840°; Ericsson, 2,726,700°; Fizeau, 7,500°; Waterston, 9,000,000°; Spoerer, 27,000°; H. Sainte-Claire Deville, 9,500°; Soret, 5,801,846°; Vicaire, 1,398°; Violle, 1,500°; Rosetti, 20,000°. The difference is, as 1,400° against 9,000,000°, or no less than 8,998,600°! There probably does not exist in science a more astonishing contradiction than that revealed in these figures.

Another of the fallacies respecting heat upon which some curious theories have been founded as to the earth's future destiny, is that of assuming that all but its crust is a mass of liquid fire. In support of this intense central heat, it was at one time asserted that the temperature of deep mines invariably increased in proportion to the depth; but doubts have, in late years, been thrown upon the statement. Still it is confidently asserted that the interior of the earth is in a red-hot molten condition, and that it is radiating its heat into space, and so growing colder. One of the results of the *Challenger* and other explorations of deep ocean is to determine that the water towards its bottom is freezing cold. Considering that the ocean covers nearly three-fourths of the entire globe, this fact certainly does not support the theory of central heat accompanied by radiation. The coldest water, it is true, usually sinks by its greater weight towards the bottom, and that, it may be said, accounts for its coldness; but, on the theory of radiation, the water of the

ocean has been for long geological ages supported on the thin crust of the earth, through which the central heat has been constantly escaping; and yet it is still of freezing coldness! Experience would say that the heat cannot have escaped through the water without warming it, because the capacity of water for heat is greater than that of any other substance. We can no more imagine such a radiation, and consequent accumulation of heat in the ocean, without the natural result of a great rise in temperature, than we can believe in a kettle resting for hours on a hot fire without the usual result of boiling water. We have no reason, therefore, to believe, as has been suggested, that the earth is growing colder, or that we, in common with all living things, are destined to be frozen out of existence and the earth itself finally swallowed up by the sun.

III. THE BACONIAN PHILOSOPHY OF HEAT.

By Dr. Akin.

IF pessimist politicians are prone to consider ordinary history as the history of practical human folly, pessimist philosopers might not inaptly describe scientific history (if such a thing existed) as the history of theoretical human error. The relative proportion of right and wrong committed, of which political history forms the record, is not inadequately matched by the ratio of truth and falsehood propounded, of which philosophical history would have to give an account; and if speculative politicians are inclined to despond upon comparing the actual state of society with what they recognise as its ideal, philosophical inquirers into the secrets of nature have little cause to feel cheerful when they similarly compare the task before them with what has been hitherto accomplished. Among the objects of which the sensations of the first human beings must have rapidly rendered them conscious, were probably light and heat, owing to the great, sudden, and frequent variations to which these conditions of human existence are liable in all climates —that is to say, if it be true, as is generally assumed, and apparently with reason, that consciousness is awakened by change. Later, when philosophers began to contemplate and ponder on the phenomena of Nature, heat, amongst others, naturally formed a principal topic of their specula-

tions; and, accordingly, from the days of Aristotle, or his precursors—whom, in the phrase of Bacon, Aristotle "had destroyed, as Ottoman emperors do their brethren, for to reign in greater security"—through almost all subsequent centuries, we have numerous expressions of opinion and statements of arguments intended to describe or demonstrate the nature of heat. Yet how unprofitable and even depressing a task would it be to follow out the history of these statements and discussions, even if we confined our attention to such as proceeded from persons of great and well-merited fame! Galileo and Gilbert, Bacon and Descartes, Boyle and Newton, Boerhaave and Crawford, Lavoisier and Laplace, as well as a host of others, have simultaneously or successively put forth views, sometimes nearly coincident, sometimes most widely discordant, as to this prolific subject of debate and research; yet the upshot of all this was, in our own century, a stolid acquiescence partly in avowedly untenable theories, partly in seemingly irremediable ignorance. The most bulky works on the subject of heat produced within this last-named period—whether they boasted the title of "theories," like those of Fourier and Poisson, or were of a practical character, like those of Peclet and De Pambour, almost confessedly slurred over the question as to the nature, essence, or, in Baconian language, the "form" of heat. Their writers took it simply for granted that heat is a something somehow capable of measurement, as proved empirically, and of exhibiting certain phenomena into whose precise mechanism or origin it was needless to inquire, it being sufficient to know by experience that they exist. Thus, after more than two thousand years of meditation, contention, and investigation, we were landed again in total ignorance, at least so far as the purpose of philosophy is to comprehend, not merely to analyse, Nature. Yet within the intricate coil, made of cobweb speculation rather than of solid scientific fibre, into which had been spun the dicta of successive generations of physicists on the philosophy of heat, there may be traced—to borrow a German simile taken from an English practice—a red thread of truth, which, originating apparently with Bacon, had been continued uninterruptedly, though without gaining in consistency, down to our own period. For a long time as good as buried in the superincumbent layers of the twisted fabric of error, this unwarped thread of truth has happily been seized upon and strengthened by some philosophers flourishing at the present time, owing to whose labours the views of Bacon have not only been drawn forth from their unmerited

oblivion, but, it is hoped, have now regained for ever their ascendency.

As already indicated, the fundamental notion of the nature of heat which it is our intention to follow through its successive stages of growth, proceeded from Bacon—the Chancellor, not the Friar. In his *Novum Organum* something like a chapter is devoted by way of illustration to an "inquisition into the form of heat"; and, whatever may be its value considered as an illustration, there can be no doubt that in this "inquisition" is contained the first, comparatively speaking, precise, if not positively well-backed, statement of what is now coming to be universally recognised as the true definition of the nature of heat. This definition, expressed in the somewhat peculiar language belonging to Bacon, is that "heat is a motion, expansive restrained, and acting in its strife on the smaller particles of matter"; to which he adds, by way of caution on what is called "sensible" heat, that "heat, as far as regards the touch of man, is a thing various and relative, insomuch as tepid water, for instance, feels hot if the hand be cold, but cold if the hand be hot." Views very similar to these were described somewhat later by Descartes, in his *Principia*; whence, probably, they were likewise adopted by Boyle, who, however, re-stated them in language much more precise and philosophical than had been used by either of his predecessors. This happened in the seventeenth century. At the beginning of the eighteenth, Newton again propounded the same doctrine, that heat is essentially but a motion of the molecules; but, unfortunately, whilst his authority contributed so powerfully to spread and sustain false ideas on the nature of light, no such overruling influence was allowed to his much sounder notions on the subject of heat. To some opinions of great novelty and importance put forth by Newton in connection with this matter, we shall have to advert to a later stage, but the merit of having advanced the Baconian theory beyond the immediate position in which it had been left by Bacon himself, by Descartes, and by Boyle, belongs to Hermann, the author of *Phoronomia*. In this work heat was for the first time defined, not merely as motion in a vague general sense, but as energy or *vis viva*, having a precise mathematical meaning. This same point of view was later adopted also by D. Bernoulli, who in his *Hydrodynamica* showed, moreover, how the elascity of gases might be accurately accounted for, instead of by the aid of an assumed repulsive force or expansive imponderable substance, as the result of the impact of the continually moving molecules on their collision with the walls of

enclosing vessels. Other philosophers of eminence living in the last century, and amongst them notably Cavendish, concurred in the same view, or at least in that which generally averred the essence of heat to be motion; and whilst some defended it, moreover, by arguments, two investigators of the highest fame in philosophy endeavoured to sustain it by experiments also. Sir Benjamin Thompson (Count Rumford) and Sir Humphry Davy, just as the century drew to its close, proved by decisive experiments that heat might not only be transferred, but actually evolved, or in a manner created, by friction; which could not be the case if heat, as was then currently assumed, was a substance, but was intelligible enough if heat was allowed to be motion. The force of this argument as well as the naturalness of the whole view which made out heat to be motion, was well put in his celebrated "Lectures on Natural Philosophy" (delivered at the Royal Institution) by Dr. Young; who, having by signal discoveries reinstated the true philosophy of light, thus contributed also to keep in some measure alive the true philosophy on the kindred subject of heat. And, though somewhat tardily, the prophecy which he uttered in reference to this matter has come right after all. With singular foresight and trust in the ultimate triumph of truth, Dr. Young in 1802, being the very time when the Baconian theory had become most discredited, expressed himself as follows:—"It was long an established doctrine that heat consists in the vibrations of the particles of bodies, and is capable of being transmitted by undulations through an apparent vacuum. This opinion has been of late very much abandoned. Count Rumford and Davy are almost the only modern authors who appeared to favour it: but it seems to have been neglected without any good reason, and will probably soon recover its popularity."

In point of fact, it took the better part of a century to make this prediction true. Wearied by the ceaseless, and for the most part baseless, metaphysical speculations which characterised the first decades of this century on the one hand, and on the other, dazzled by the prodigious development of the power of mathematics, which occurred at nearly the same time, natural philosophers had begun to shun all topics bearing ever so slight a resemblance to metaphysics, taking refuge instead in the processes of mathematics, which had been found capable of evolving the greatest multiplicity of practical results from the smallest possible stock of physical notions. Yet though by tacit consent purely theoretical questions may be generally eschewed, the

necessities of practice itself seldom fail to start them anew in some shape or other; and to this general rule the problem touching the nature of heat has not been formed an exception. Whilst Davy and Rumford had attempted to settle the point by an investigation into the excitation of heat due to mechanical force, as in friction, it was now the study of the reverse process, or of the development of mechanical force by heat, as in the steam engine, by which the question was again brought under discussion. The first to start this practically, no less than theoretically, important inquiry into the production of motive power by the agency of heat, which until then had been neglected, was S. Carnot; who, in an essay published now just forty years ago, proposed a theory according to which the evolution of force by heat was owing to a degradation of temperature, not of bodies, which would involve losses of heat, but of quantities of heat, which thus remained undiminished—similarly as masses of water, by a change of level, can impart movement to other bodies without undergoing any *material* diminution. This view, though radically false, as must be apparent to any one who analyses the simile just employed, suggested by Carnot himself—involves nevertheless an element of truth of great practical importance. And, in an equally singular and tortuous manner, the little pamphlet in which this theory was published contributed in a greater measure to revive, and ultimately re-accredit, sound notions on the nature of heat—including, by construction, the correct solution of the mechanical problem primarily attacked by its author—than almost any subsequent publication. Ere, however, the influence of Carnot's essay had made itself felt upon this wider basis, the more limited question which he had attempted to solve had been fully determined. To this result three investigators contributed independent and diversified shares. M. Seguin, fifteen years after Carnot's contrary assertion, maintained that, in the production of mechanical force through the intervention of heat, heat was absolutely lost, and that between the amounts of heat so lost and the amount of force so gained there existed an invariable numerical ratio, which he attempted to calculate, but only with partial success. Starting from more comprehensive premisses than Seguin, but agreeing with him in the particular question before us, Dr. Mayer, a few years later, succeeded in deriving the numerical value of the magnitude sought to be determined by Seguin, with as much accuracy as the then state of knowledge of the subsidiary data of his calculations permitted. Lastly, but a

few months after Mayer, Mr. Joule, from experiments especially undertaken for the purpose, published values of his own of the same quality, previously but indirectly computed by Mayer.

It is curious to note the different points of view which these three authors, as well as their predecessor Carnot—working, as far as is known, independently of one another, and with such diversified results—assumed relatively to the question of the intimate essence of heat. Carnot, who throughout his pamphlet had reasoned as if heat were a fluid capable of producing motion (but it was not proved owing to what cause) in the same way as flowing water does, had nevertheless explicitly asserted that heat was but molecular motion. Seguin and Mayer, on the contrary, had considered heat and motion to be interchangeable; but nevertheless the first of them pronounced the question as to the nature of heat to be for the present inapproachable, whilst the latter had distinctly denied that heat could be motion. Mr. Joule, finally, who was agreed on the mechanical question with his two last-mentioned predecessors, asserted at the outset, like Carnot, that heat essentially could only be motion. And this foregone conclusion of Mr. Joule, as soon as he had proved by decisive experiments that a given quantity of motion produced under all circumstances the same quantity of heat, became, if not an irresistible, at least a most plausible, inference from facts. Mr. Joule had found that the energy which, when involving finite motion, is expressed as 772 footpounds may be converted into exactly one conventional unit of heat; which, if it does not prove, finds at all events its most natural explanation in, the assumption that the unit of heat expresses similarly a quantity of energy, involving, however, no longer the finite motion of complexes of masses, but the infinitesimal excursions of the molecules of masses. Accordingly, in the conversion of motion into heat, or *vice versa*, there is no transmutation implied of two heterogeneous things into one another, but only a transformation of finite excursions into infinitesimal, due to the transfer of velocities from entire bodies to their component molecules. If the measure of heat be only rational, or at least fixed, and thus indicate correctly the amount of motion gained or spent in each case, it cannot fail to result that a certain relation subsists between that measure and the measure of energies ordinarily applied to finite excursions. Actually, this relation is such, as demonstrated by repeated practical comparisons, that if a quantity of *water* be allowed

to fall through the space of 772 feet, and the complexual velocity of 222 feet which it has then acquired be coverted into molecular velocity by arresting the further fall of the whole mass, the temperature of the water will have increased just 1° Fahr. This is what is understood by—and only in this way can be really understood—what is called the *mechanical equivalent of heat.*

Thus the most natural inference to be derived from the investigation of the generation of motion by heat, or *vice versa*, strongly corroborates the truthfulness of the Baconian notion of heat. Soon after Mr. Joule's experiments, this view was adopted by notable physicists and mathematicians, being almost immediately applied by Mr. Joule himself to the explanation of the theory of gases—a task in which he unconsciously only reproduced the previous results of Bernoulli, which later again were re-discovered by Dr. Krönig. This subject has since been fully developed and brought to a considerable pitch of perfection by several authors, to whose labours and authority it is not a little due that the Baconian philosophy has since found a great number of adherents. But whilst the researches we have hitherto mentioned all confirm the adequacy of the Baconian view to explain known facts, there is another field of investigation whence proof may be derived of, perhaps, its necessity. Even more intimately connected with the question before us than the phenomena hitherto discussed are those designated by the name of radiant heat; and these, more than any other, afford us the direct clue to the nature of heat. Nearly two centuries ago, Mariotte apparently succeeded in separating the effects of light from those of heat, from which it seemingly followed that these agents must be different also as to their origin. On the other hand, numerous experiments had indicated a certain similarity between light and heat under particular conditions, especially as to their mode of prorogation; hence it was concluded that heat was capable of manifesting itself under certain circumstances in a form which, from its similarity to radiant light, was called radiant heat. What radiant heat really was, very few philosophers even of the first half of this century understood; yet Newton, nearly two hundred years ago, had given an accurate account of it. According to Newton, what is called radiant heat are the vibrations—or, more correctly, the undulations—of an all-pervading ethereal medium, concerned also in the propagation of light, and which, arising from the vibrations of the molecules of bodies called hot or warm (but whose

temperature may, in reality, be any whatever), produce the effects of heat on those bodies which they impinge. So much being granted, the further question arises, what is the relation between the undulations just described, and those other undulations which are now generally recognised (although Newton would not allow it) to constitute light in its state of propagation? It had been found that the invisible radiations which produce but effects of heat were liable to exactly the same vicissitudes as the visible radiations which, besides general effects of heat, produce also in our eyes the particular sensation denoted as light; and, from a great discovery made by Sir W. Herschel, it was known also that among invisible rays there exist varieties of refrangibility entirely similar to those which Newton had discovered among the visible—limited, however, by this, that the most refrangible of the invisible rays just equal in refrangibility the least refrangible of the visible rays. The natural inference from all this—which Herschel also at first had recognised, but from which, at a later period, owing to a strange misunderstanding, he dissented—was stated at the beginning of this century by Dr. Young in the following words:—"Suppose the undulations principally constituting [invisible] radiant heat to be larger than those of light; while, at the same time, the smaller vibrations of light, and even the blackening [sometimes called photographic] rays, derived from still more minute vibrations, may, when sufficiently concentrated, concur in producing the effects of heat. These effects, beginning at the blackening rays, which are invisible, are a little more perceptible in the violet, which still possess but a faint power of illumination; the yellow-green possess the most light; the red give less light but much more heat; while the still larger and less frequent vibrations, which have no effect on the sense of sight, may be supposed to give rise to the least refrangible rays, and to constitute invisible [radiant] heat." According to this view, invisible rays differ from visible intrinsically but in the same respect as the blue, for instance, differ from the green rays—namely, in point of degree; although physiologically the difference both between visible and invisible rays, and between blue and green rays, is immense. After considerable hesitation and contention, the opinion of Young has now become almost universally adopted—it being proved, on the one hand, that invisible and visible rays are alike in nature, and on the other, that the pretended separation of light from heat reposes in reality only on the separation of invisible and calorifically strong from visible and calorifically less powerful

rays. Now, if it be allowed, first, that invisible radiant heat and visible radiant heat (which is the same as radiant light) are essentially alike; and secondly, that radiant light consists in undulations due primarily to molecular vibrations —which latter point was even allowed by Newton and is confirmed by signal discoveries made within recent years—and which differ from radiant heat that is invisible only in the physiological accident of perceptibility by the eye; it necessarily follows that what under all circumstances when propagated from one body to another, produces effects of heat, and in animals sometimes produces the sensation of light besides, consists in those very molecular vibrations which, when of a certain pitch, are capable of giving us the sensation of light, but otherwise only the sensation of heat. In other words, from the correct interpretation of the phenomena of radiant heat it results that heat, "its essence or quiddity," as Bacon said, is motion.

The fruitfulness of the Baconian definition of heat has, since the brief period of its revival, shown itself already in various ways, and it is impossible to overlook how great its influence is becoming in remodelling our traditional systems —if systems they may be called—of philosophy. Considered in its most enlarged aspect, it suggests an almost entirely new view of the whole of nature. In the words of the essay, of which the present forms an abstract:—"If heat is motion—and this is the distinctive point of the new or revived philosophy—it follows, from all what we observe, that the condition of material existence in the universe is motion, not rest. We may imagine in our minds quiescent matter, but nature affords us no such example. Whatever may be thought of its horror of a vacuum, nature certainly seems to abhor rest. Not only is the condition of life in superior beings, as identified with the circulation of sap and blood, motion, but inanimate systems also seem unavoidably pervaded by motion. The earth as a whole moves, so do the other planets; even the sun and the fixed stars move. And as in the solar and other starry systems in heaven each great component mass perpetually rotates round its central axis, revolves round its central body, and with it partakes of a motion in progression, or perhaps alternately backwards and forwards; so every atom also in the most impalpable cluster of molecules—being, like all things in nature, impregnated with heat—rotates, revolves, advances, and retrogresses for ever in the infinitesimal space allotted as the scene of its ever-changing existence."

IV. MYSTICISM AND ASCETICISM.*

THERE is something almost startling in the clash of opinion that makes itself heard at the present day. We find men of culture and standing, graduates of universities and members of learned professions upholding in evident good faith doctrines which differ from each other respectively even more widely than from generally received beliefs. On the one hand we hear the calmly dogmatic denial of a spiritual element in man, of a future life and of a personal Deity; on the other we perceive a revival of what our grandfathers derided as worn-out superstitions, a belief in "occult science," in demoniacal possession and in magic.

The world at large shakes its head at the Materialist, sneers at the Mystic and passes on its way, muttering perhaps the old question "What is truth?" and leaves the decision of the great questions raised to the mercy of accident.

Not all minds, however, can reconcile themselves thus easily to the chaos of theories now prevailing. If we are so completely in error as both the Materialist and the Mystic agree in asserting, not merely our philosophy but our daily practices must be profoundly erroneous, and require revision. Our science, it must be confessed, is not only very limited, but it involves a fearful amount of unproved assumptions. Naturally then, we cannot—ought not to—shut our eyes against any additional light provided we can feel sure that it is light. Here then lies the difficulty. Can the professors of Occult Science make good their claims? If they possess the knowledge and the power ascribed to them by Dr. W. there can be little difficulty. Thus we are told that certain Hindoo adepts are able to raise themselves up in the air, influence the weather, or to call up storms unlimited in extent and violence. Be it so: let then one of these sages float, not in a building or in a cavern, but under the open sky. Let him, for instance, soar from the Monument to the Victoria Tower at Westminster, fly across the Thames, or even hover along one of our main streets above the heads of the crowd. Or if, as the author hints, our

* Theosophy and the Higher Life, and Spiritual Dynamics and the Divine and Miraculous Man. By G. W....., M.D., Edin., President of the British Theosophical Society. London: Trübner and Co.

climate may not admit of the display of such powers, let the experiment be made at Calcutta or Bombay. If an adept does so then assuredly no "scientist will desire either to place him in a madhouse or hale him before the magistrate." He who is able to perform a crucial experiment and refuses so to do has little room to complain if his doctrines meet with no acceptance, and if their rejection is an injury to the world he incurs, as it seems to me, a very grave moral responsibility. When a man of science has obtained a novel and important result he makes every step of his procedure fully known, so that all who feel interested may themselves judge whether he is in the right or in error. Suppose that when Davy discovered potassium he had neither exhibited his product before those capable of judging, nor described its source and the manner in which it might be obtained, but had contented himself with saying that he had produced a metal so light as to float upon water and capable of taking fire if moistened: had he done this he would have met with not credence, but rebuke.

Again, if any Hindu adept can influence the weather, the death of all his countrymen who perished of famine lies at his door.

Further we read:—Hence the adept can consciously see the minds of others. He can act by his soul force on external spirits. He can accelerate the growth of plants and quench fire, and like Daniel subdue ferocious wild beasts. He can send his soul to a distance and there not only read the thoughts of others, but speak to and touch these distant objects; (what objects?) and not only so, but he can exhibit to his distant friends his spiritual body in the exact likeness of that of the flesh. Moreover, as the adept acts by the power of his spirit he can as a unitive force create out of the surrounding multiplex atmosphere the likeness of physical objects to come into his presence."

It need scarcely be said that any person thus endowed could, if he thought proper, demonstrate his pretensions quite as easily as the engineer can exhibit the uses of some newly invented machine or the chemist display the attributes of a recently-discovered compound. Nay, the task of the adept should be the simpler and easier, requiring as he does neither models, apparatus, nor materials. The whole spirit of the Inductive Philosophy,—which is after all merely organised common sense, bids us suspend judgment where facts are not forthcoming. We accept the testimony of a Hofmann, a Würtz, or a Bunsen as to a new chemical fact, simply because we know that their experiments will have

been repeated in a hundred laboratories, and that these eminent men have been conscious that such scrutiny would follow. Surely, therefore, all who have new truths of any kind to bring forward should be prepared to meet this reasonable demand, and should be the more careful both as to the quantity and quality of their experimental evidence the stranger the conclusions which have to be demonstrated.

On the other hand, it must be owned with regret that facts which do not square with established opinions are received not with critical scrutiny, not with a philosophical suspension of judgment, but with an obstinate and prejudiced scepticism; with the wish and the determination to find nothing but jugglery and imposture. Such a spirit is, if possible, more misleading than the grossest credulity.

Any thoughtful person on taking up Dr. W.'s work, which differs little in its teachings from Bulwer-Lytton's "Zanoni," will above all things wish to know how the knowledge and power of the adept are to be obtained? He will ask if the teachings of occult science supplement and extend those of open and acknowledged science, and if its spirit and its methods are similar? The replies to these questions are not satisfactory. We may read the chapter "How best to become a Theosophist," not as sceptics or scorners but as earnest searchers for truth, yet we shall find in the instructions nothing feasible or tangible. No intellectual discipline is enjoined; indeed occult science seems more an affair of the will and of the moral faculties than of the reason. The course of training prescribed consists mainly in austerities and asceticism,—of which more anon—and in contemplation rather than speculation.* The adept is subjective rather than objective in his endeavours. He does not seek to sharpen his senses, or to improve his observant faculties, but the reverse.

As I gather from another source "he learns to live underground, and for this purpose he digs a subterranean cavern (the *gublia*) in which he passes most of his time. The temperature must be warm and perfectly even, and the cavern is entered only by a hole which can be closed with a stone. Indeed, the essentials of the mode of life are the complete exclusion of free air, impenetrable darkness, and an unbroken silence. He lies upon a pallet of cotton or wool—something warm and soft—at the bottom of this subterrranean cell, and repeats from day to day the mystic

* I use this term in its true and original sense and not as an apologetic synonym for gambling and thieving.

word "Om," the Hindoo name of the great abstraction of universal life—a being more transcendental than that of Hegel. The devotee takes occasional walks, but is very slow in his movements, so as to lessen the rapidity of the respiration. He repeats his "Om" sometimes 10,000 times a day, and has other syllables among which are "Bam," "Ham," "Lam," "Ram," "Soham," "Yam," of which he performs endless series of repetitions, arranging them in every order of which they are susceptible, and rigidly following a prescribed order for a given number of repetitions. He trains himself to sit squatted for hours together in a certain peculiar attitude (the *siddhasana*), which consists in doubling the left leg under the body, so as to rest upon the heel of the left foot, while the right leg is extended forward. In this position, with the right arm advanced, he holds the big toe of the right foot in his right hand, and with the left arm flexed under the body, grasps the big toe of the left foot. This brings the lower part of the face to rest on the breast bone. In this awkward and difficult attitude the fakir sits for hours together; that is, when he is not standing upon his head or training himself to take a deep inspiration and expel it slowly—taking twelve seconds to breathe it and twenty-four to breathe out the cubic feet of atmosphere that the lungs can contain. Besides these exercises, his tongue has to be cut twenty-four times, so as to sever all the ligatures one by one, and enable him to flex it backward and close the throat with its tip."

Dr. W.... does not, indeed, advise a similar way of life for those who are aspiring after the "Christian adeptship of the West." But his recommendations plainly tend o an intensification of that phase of our being which concerns itself with moral good and moral evil. In the modern savant as met with in Europe and America this phase is comparatively less prominent than in ordinary men of the world. He must, indeed, possess in an eminent degree the virtues of industry, patience, and perseverance, and his truthfulness must be beyond suspicion. Nor can he indulge in sensual excesses of any kind without traversing his own career. But his mind is mainly set and most intently fixed on matters which are neither good nor evil. This peculiarity was perhaps most clearly manifested in Henry Cavendish, a man incapable of love or hatred, of fear or hope, and simply absorbed in the study of certain classes of physical phenomena. There is probably no other known case of a complete atrophy of man's emotional nature. Still we may learn from this extreme instance that the savant and the theosophic

adept represent opposite poles of humanity. The more closely we approach the position of the one the more widely we are separated from that of the other. Hence I see no hope that occult science even if it should succeed in substantiating its claims, can supplement and extend our present knowledge.

But I may raise the question whether a course of training such as that undergone by the fakir is not eminently calculated to promote hallucinations and delusions of every kind? One of the main points of his discipline is a reduction as far as possible of the respiratory process. He must learn to breathe slowly, and the atmosphere of his underground cell will undoubtedly become very foul.

As a matter of course the aëration and purification of the blood will be very imperfectly performed,—a state of things that cannot but react injuriously upon the brain, especially in conjunction with the exercise of standing upon the head. It would be hard to conceive a mode of life more unfitted for a sober truth-seeker. That by these means the adept ultimately becomes capable of existing in a state of trance for weeks or even months, during which circulation and respiration are apparently suspended, seems fully proven. But this sham-death is after all merely an artificial reproduction of the winter-sleep of certain animals and can scarcely be accepted as a higher life than that of waking man. Such an adept seems to me rather an object for observation and experiment than as being himself an investigator and discoverer.

There is another feature in the teachings of the Theosophists which must not be overlooked—the glorification of asceticism. I have very little sympathy with or respect for the sensualist, but the ascetic I regard with loathing mingled with dread. The austerities and torments which he inflicts upon himself he is ever ready, if opportunity offers, to force upon others. Almost every persecutor, every ecclesiastical tyrant, of whatsoever creed, is recorded as given to fasting and penances.

An every-day observation proves the demoralising tendency of asceticism. Every man is harsher, more severe, less obliging when hungry than when satisfied,—a truth which extends to the very beasts.* What then must be the accumulation of "envy, hatred, malice, and all uncharitableness" in a man who is always hungry? The ascetic, if sincere, is a Torquemada, a Tilly, or a Cotton Mather; if

* The Lent of the Greek Church and the Ramalan of Islam are saturnalia of all crimes of violence and cruelty.

insincere he is an Angelo. What a grim choice! I have somewhere read that every virtue is the golden mean between two equal and opposite vices which are alike to be avoided. Now the ascetic not merely practises a vice, but, unlike the sensualist, he even glories in it and pronounces it a virtue. He calls evil good, and may thus be regarded as a demon-worshipper.

I may venture to call attention to the following exceptionable passages in Dr. W.... 's work.

To the adept, we are told "alcohol is strictly forbidden and the flesh of animals." This is a strange declaration from one who recognises Jesus of Nazareth as the highest of adepts, though described as partaking both of wine and animal food and of whom it is written* "The Son of Man came eating and drinking."

We are next told :—"It is a remarkable fact that among the lower animals, the female, who generally becomes pregnant by a single act, so long as she is pregnant, rejects all further approaches of the male with anger and indignation. Does nature not in this wonderful fact teach man?" This "wonderful fact" does not hold good among the *Simiadæ*, the animals, be it remembered, most nearly approaching man.†

Elsewhere we read :—"We know that the air-plant flourishes without any soil and that gold-fish flourish in pure water without visible organic food." Can Dr. W. prove that gold-fish elaborate from water and air all the elements needed for a healthy life? Air-plants, too, receive nourishment from the juices of the trees or the decaying wood to which they cling, or even from the dust, organic and inorganic, floating in the atmosphere. It will be quite time enough to assert that they can flourish without any soil when they are found to grow and obtain all their necessary elements from distilled water and air fitered through cotton-wool.

These errors relate merely to illustrations and to points of secondary importance, but they show a want of accuracy and thoroughness which leaves a disagreeable impresion upon the thoughtful reader. If the author is not to be trusted in such simple and familiar questions will he prove a safe guide in matters more recondite?

I cheerfully admit, indeed, that there is much between

* Matthew xi., 19.

† It breaks down in other quarters also. But may we not remark that the very essence of asceticism is to disregard what Nature teaches.

heaven and earth not dreamt of in our commonly received philosophy. But I fear lest such teachings as those of Dr. W. may not tend rather to obscure truth and hinder its recognition. Above all I hold that every friend of humanity should wage a war of extermination against asceticism as one of the foulest survivals of ignorance and savagery.

FRANK FERNSEED.

V. THE SANITARY MILLENNIUM.*

NO opinion is more common among the educated classes than that man's control over the forces of nature is becoming almost complete and that if any ruinous catastrophe occurs it is because the authorities or the public do not make use of the power and the knowledge they possess.† It is hinted that a sunless, dripping summer is due in some mysterious manner to the malfeasance of an administration; and it is openly suggested that if cholera, or typhoid, or small-pox, or any other epidemic henceforth breaks out in a town the municipality or other governing body should be subjected to severe penalties as having neglected their duties. It is, of course, exceedingly satisfactory to read an account of the Black Death in the fourteenth centvry, of the Plague of London in 1665, or of Marseille in 1720; of the visitations of epidemic dysentery, of sweating sickness, and the other forms of pestilence which attacked the known world every few years from about the 7th century to the middle of the 18th—and then to be told on official authority that we have "changed all this;"—that horrors of such kind are no longer possible.

For have we not now fifty years ago inaugurated "sanitary reform?" Have not certain learned men discovered for us that the only cause of the so-called zymotic diseases

* Epidemiology; or the Remote Cause of Epidemic Diseases in the Animal and in the Vegetable Creation. With the Cause of Hurricanes and Abnormal Atmospherical Vicissitudes. By JOHN PARKIN, M.D. Part II. Second Edition. London: David Bogue.

† Thus the editor of the *Lancet* (December 23, 1871) commenting on the fact that in the same year 13,174 persons had died of small-pox in the seventeen chief towns of England, pronounces the fact "discreditable to the intelligence of the rulers and people of this country."

is dirt? That if we take care to keep our drinking waters free from pollution, abolish cess-pools, ventilate our houses, and avoid overcrowding, we may laugh at epidemics, and may, if we wish, reduce our death-rate to five or six in the thousand? Have we not spent some 300 millions of money in carrying out these teachings and in paying the fees of our teachers?

That we have parted with the money is a truth that cannot be gainsaid. But in view of the importance of the subject it will not be deemed any undue outbreak of scepticism if we ask what we have purchased therewith, and whether our modern security is as well-founded as we think.

For a better understanding of the case let us first refer to the plague in London in 1665,—the last be it observed of 22 visitations of the same disease in England. We are commonly told that the great fire of the succeeding year thoroughly purged the city, which was rebuilt in such an improved manner as regards cleanliness that the recurrence of the disease has been thereby prevented. A little reflection will show us that here lurks an error. Plague had not been confined to London; it had from time to time ravaged the provincial cities and even the villages of England. Surely the fire of London could not improve their sanitary condition or secure them from further visitations. Nor could it in any way explain the gradual disappearance of the scourge from all parts of western Europe. Its last outbreak in France occurred at Marseille in 1720. Now it cannot be contended that either in England or in France any very marked change had taken place betwen the years 1650 and 1750. Social and domestic arrangements had not been so modified as to explain this cessation of pestilence. No additional precaution had been taken, and the intercourse between different nations —and in consequence the supposed facilities for the transmission of disease—was all the time increasing. Since then the plague has been confined to Egypt and Turkey, and even there its ravages have become less frequent and less severe, and till within the past few years it seemed likely to cease altogether. Yet in the East nothing bordering upon sanitary improvement has been undertaken. Surely then it must be conceded that the gradual recession of the plague from Europe and its almost extinction in Egypt, Syria, and the adjacent regions cannot be attributed to any human agency.

Let us now return to England: according to Dr. Percival and Mr. Griffith Davis in 1757 the death-rate in Manchester

was 1 in 25, or 40 per thousand. In 1770 it had fallen to 1 in 28, or 35·71 per thousand, and in 1811 to 1 in 74, or 13·51 per thousand. Here, then, is a distinct and rapid advance towards the much talked-of "sanitary millennium,"—a decrease of mortality to the extent of two-fifths! Since that date most remarkable changes have been effected. Medical science has improved, the condition of the people has been ameliorated, the hours of work in factories have been limited, vaccination, which, in 1811 was merely optional, has been rendered compulsory, and "sanitary reform" has been fully inaugurated. In all these benefits Manchester has participated, and since about 1845-50 it has enjoyed the special advantage of an ample supply of water drawn from the unpeopled and uncultivated moorlands of north-west Derbyshire, where organic pollution seems out of the question. We might reasonably then expect that the advance above mentioned would be sustained, and that the death-rate of the great cotton-city would have fallen to—at most—1 in 100 or 10 per thousand. But alas! in the ten years from 1851 to 1860 inclusive the mortality has been 31 per thousand!* In other words, in spite of all our modern sanitary reforms, the death-rate has increased to more than double its amount in 1811.

Hence we are again led to the conclusion that the reduction of mortality which characterised the latter half of the 18th century and the beginning of the 19th is not due to modern science, to advancing civilisation, or to any human agency. From the evident impotence of "sanitary reform" to maintain the improvement which had taken place we are also warranted in questioning the soundness of the principles on which it is based.

Amongst the diseases which had become less frequent and less severe, but which have since resumed an epidemic and highly dangerous character, a prominent place is due to small-pox, especially as its alleged preventive, vaccination, has taken rank among the political questions of the day. We are told that if this disease no longer carries off its victims by tens of thousands, as in the dark ages, the change is due to vaccination. But there can be not a shadow of doubt that small-pox had begun to decline long before the discovery of Jenner was introduced into practice.

In 1722 Dr. Wagstaffe wrote that the mortality among children did not exceed 1 per cent. of the cases. From 1796

* According to the returns of the Registrar-General (September 25th, 1880) it has been for the past week 27 per thousand.

to 1825 there was not a single epidemic of small-pox in England. Yet, according to a report published by the College of Physicians in 1807, only about 1½ per cent. of the population were vaccinated. Now if we admit that the immunity gained by this operation is absolute and permanent, how is it possible that 3 vaccinated persons out of every 200 would protect the remaining 197? At the present time about 97 per cent. of the population are supposed to be vaccinated. Yet so far from being able to protect the residual 3 per cent it is considered that they are imperilled by the obstinacy or neglect of this small minority. We have the lamentable fact that, whilst vaccination has become all but universal, small-pox has reappeared among us not in isolated cases but in epidemics, succeeding each other at short intervals, and each more deadly than the foregoing. Thus in the epidemic of 1857-58-59 the deaths were 14,244; in that of 1863-64-65 20,059, and in that of 188c-71-72 44,840. Thus in the first interval the deaths from this cause had increased 50 per cent, whilst the population had grown only 7 per cent. In the second interval the deaths from small-pox have risen by 120 per cent, but the population only 10 per cent. Another ugly fact is that the number of persons who have been vaccinated but who are subsequently attacked with small-pox is steadily on the increase. At the Highgate small-pox hospital from 1835 to 1851 the previously-vaccinated formed 53 per cent of the total small-pox cases admitted. In 1851-2 it rose to 66·7 per cent; in 1854-5-6 to 71·2 per cent; in 1859-60 to 72; in 1866 to 81·1 and in 1868 to 84 per cent. How are such facts to be reconciled with the orthodox theory that vaccination is a safeguard against small-pox? What would be the conclusion formed by an unprejudiced statistician if these figures were laid before him? If *a* grows more common as *b* increases in number and general distribution no man in his senses will argue that *b* is a hindrance to *a*. The very opposite conclusion, that *b* is causally connected with *a* would seem more legitimate. How the credit of vaccination is to be saved is not apparent. We cannot cut the knot by supposing that modern medical practitioners are less careful and skilled in the performance of the operation or less scrupulous in the selection of vaccine lymph. There remains, then, merely the conclusion that small-pox, too, has had a period of cessation during the latter part of the past century and the first quarter of the present;—that the apparent success of vaccination was mainly due to its coincidence with this temporary lull, and that the disease is

now rapidly regaining its old virulence and re-assuming the pestilential proportions which it displayed in the days of our forefathers.

We can now appreciate one portion of Dr. Parkin's theory. He holds that there occur certain "pestilential epochs" during which the world is at frequent intervals devastated by epidemics which travel in a determinate direction from central or eastern Asia to the west of Europe and even to America; that during such epochs all diseases, even those not considered as communicable from one person to another, increase in frequency and in violence; that these epochs are further marked by epizöotics and by "blights" or wide-spread diseases in the vegetable world, and are attended by a general intensification of earthquakes, storms, floods, droughts, fogs, seasons of abnormal heat or cold, and other convulsions of inorganic nature. Such an epoch is generally ushered in by the appearance of new diseases or of the reap-appearance of maladies that had become obsolete. Dr. Parkin holds that tbe last great pestilential term began about the 7th century. The advent of plague was accompanied by measles, small-pox, and malignant sore throat. From that time to the beginning of the 18th century Europe and western Asia were almost incessantly ravaged by epidemics, among which the plague, or Black Death, was most prominent and most formidable. During all these hundreds of years there was no such freedom from pestilence as western Europe has enjoyed between 1750 and the advent of the cholera in 1830.*

This non-pestilental period presents some most remarkable features. The year 1759 saw the close of a violent epizöotic, and from that time till quite a recent date England has been free from any generally prevailing disease among cattle. About 1692 the yearly deaths from dysentery in London had exceeded 2000. In 1799 they only amounted to 13! Between 1728-38 the burials of children under two years of age averaged in London 10,000 yearly. Between 1790-1800 they had fallen to 6000.

The author further declares that after the great earthquake of Lisbon in 1755 terrestrial concussions declined in Europe and Asia both as regards numbers and violence. The season of 1766-7 was the last of those visitations of

* Nevertheless we must not forget the outbreak of yellow fever at Malaga in 1803, which carried off 36,000 persons and was accompanied, according to Waterton, who was then a resident in that city, by seven shocks of earthquake.

intense cold which survive in tradition as "old-fashioned winters."*

Dr. Parkin also holds that whilst the pestilential epochs are marked not merely by physical but by mental diseases and by delusions, the non-pestilential epoch is characterised by an awakening from errors and superstitions. He writes:—"The mists which had so long obscured the human intellect, particularly during the Dark and Middle Ages, became suddenly removed. . . . It was then also that the glorious galaxy of intellectual stars made their appearance—Galileo, Kepler, Newton, Descartes, Bacon, Locke, Shakespeare, Milton, Dante, Molière, Corneille, Goethe, and a host of philosophical and scientific writers to whom we are indebted for those great discoveries that have enriched the present century."

We are by no means disposed to deny that a pestilential epoch may be fertile in delusions, a subject to which we may return below. But the great French revolution which, with its attendant wars, entirely belongs to the non-pestilential epoch (1750 to 1830) was rich in delusions. With the "intellectual stars" above enumerated we feel perplexed. We do not see how any of the names mentioned, with the single exception of Goethe, can be considered to belong to the "non-pestilential epoch."

In support of the view that we have entered upon a new period of epidemics the author adduces as evidence the appearance of cholera, of which we have had three successive visitations, the recrudescence of small-pox, the advent of diphtheria, the prevalence of typhoid, the increase of carbuncle, typhus, scarlet fever, and diarrhœa, the recent epizöotics, rinderpest, foot and mouth disease, the increase of rabies, and the maladies among vegetables, such as the vine, the potato, and we may add the coffee tree. Delusions are also growing apace—Dr. Parkin selects as an instance ritualism, a subject which does not lie within our limits. He might perhaps have here brought forward vege-

* Here, again, we must make a reservation. According to White, the frost of 1768 was the "most intense that we had then known for many years, and was attended by an epidemic among horses." The winter of 1771 was long and severe, the snow lying for eight weeks in the island of Skye, where snow seldom lies at all. In the spring following most of the cows were barren, the sheep perished for want of food and the grass did not grow. In 1776 the roads in the west of England were blocked up with snow; at Selborne the thermometer fell to 7° and 6° Fahr., and in Kent to −2°. The summer of 1783 is described as "amazing and portentous." A reddish fog covered all Europe for weeks, irrespective of changes of the wind. Calabria and Sicily suffered from earthquakes, and thunderstorms were unusually violent and numerous.

tarianism, the woman's rights movement, Mormonism, Nihilism, and the general tendency to political agitation.

In dealing with the causes of epidemics, the author is, in our opinion, perfectly successful in disposing of the two most popular theories, the dirt doctrine of the sanitary reformers, and the notion of contagion. The facts which he mentions, most of which are common matters of history, are decidedly opposed to both. Thus, when pestilence reaches a great commercial centre—*e.g.*, the Black Death at Constantinople in the 14th century—it does not, as the contagion theory would require, radiate out on all the lines of traffic, but selects some single track. Even the Black Death did not pass northwards from Constantinople to Russia, but turning westwards coasted the Mediterranean, passed through France into England, thence to Norway and Sweden, though the intercourse was then exceedingly slight, and lastly passed into Russia. The cholera has been known to travel steadily for hundreds of miles in the teeth of a strong monsoon. It often works up a river, showing that it is not occasioned by infectious matter draining into the current. Pestilences have generally been found more violent in open airy places than in such as are close and sheltered. The yellow fever haunts the breezy Antilles and the coasts of Brazil and of La Plata, but penetrates inland only in proportion as the forest is cleared away. In the epidemic of cholera in Trinidad in 1854 the mortality at the leeward end of the streets was less by 5 per cent than at the windward end. Houses on open roads were attacked, huts in the bush escaped. Alike in epidemics of plague, cholera, and yellow fever, it has been found that classes of people who from occupation or habit were most exposed to the air suffered most, whilst those who kept themselves shut up escaped. How ill this agrees with the teachings of the sanitary reformers!

We must now turn to Dr. Parkin's own theory. He refers pestilence to what he calls "volcanic action," understanding thereby not merely eruptions and earthquakes, but the more quiet and continuous agency of which earthquakes and emissions of lava are the occasional and palpable results. He affirms that both earthquakes and epidemics are most common and most destructive in alluvial districts, and on the contrary rarer and less violent among the mountains. As regards earthquakes we cannot accept this opinion without hesitation. The western mountainous region of South America is far more troubled with earthquakes than the comparatively level lands of Brazil and Guayana, including

the alluvial valleys of the La Plata, the Amazon, and the Orinoco. In Europe earthquakes have occurred chiefly in the mountainous peninsulas bordering on the Mediterranean, and the adjacent islands, whilst the great plain extending from northern France through Belgium, Holland, North Germany, Poland, and Russia, has, in historical times, suffered little from this agency.

Iceland, Jamaica, New Zealand, all mountainous, have all been the scenes of great volcanic activity. On p. 117 the author remarks that "in the region of the Andes, the oldest range of volcanos next to extinct volcanos, epidemics would appear to be unknown, while endemics are extremely rare. Dr. Bryson states that with some few exceptions in which ague and malarious fevers exist, both sides of this volcanic chain are extremely salubrious." Yet he elsewhere speaks of yellow fever as occurring at the port of Islay on the western side of the chain.

Dr. Parkin, if we understand him aright, considers that springs are more abundant in alluvial tracts than in rocky districts. This is exactly opposite to what we have always found. Springs are, *e.g.*, far more numerous in the mountainous districts of Cumberland, Westmoreland, and North Wales, than in the valleys of the Thames, the Trent, and the Mersey, or in the plains of Buckinghamshire, Essex, Suffolk, Huntingdon, Cambridge, Bedford, &c. This is a point of some moment if, according to Dr. Parkin's fourth law, "the effects of volcanic action—and if his theory be correct epidemic diseases—are always much greater and more perceptible near the sea, lakes, rivers, *springs*, &c."

There are, therefore, several points on which we should desire further light before we can accept the causal connection between pestilence, volcanic action, and abnormal meteorological phenomena as proven. Nor can we forget that much of the historical evidence brought forward as to the earthquakes, storms, floods, famines, and the like visitations in the Middle Ages, is not absolutely free from suspicion. Even if we absolve the old chroniclers of any intentional exaggeration, they had very scanty means of ascertaining the truth. There were in those days no observers armed with thermometers, barometers, wind and rain guages. The descriptions which have been handed down to us are merely the guesses or the random fancies of ignorant peasants transmitted by hearsay from district to district, and from kingdom to kingdom. It is only from the beginning of the 17th century that the record can be accepted as trustworthy.

We consider Dr. Parkin's work, however, worthy of the most serious attention. It literally teems with important facts and suggestive reflections. Nor should it be overlooked by the mass of the public as a treatise addressed solely or mainly to the medical profession or to those versed in biological science. Apart from the fundamental hypothesis that "volcanic" action is the main factor influencing public health, and the condition of the weather, we find here very much which is assuredly true, and which ought to be known by all educated men. If the author is not mistaken in his forecasts political economists have little need to trouble themselves about the population question. Perhaps, too, some of the political complications of the day may receive a solution little dreamt of by statesmen.

ANALYSIS OF BOOKS.

Insect Variety: its Propagation and Distribution. Treating of the Odours, Dances, Colours, and Music in all Grasshoppers, Cicadæ, and Moths; Beetles, Leaf-insects, Bees, and Butterflies; Bugs, Flies, and Ephemeræ; and exhibiting the bearing of the science of Entomology on Geology. By A. H. Swinton, Member of the Entomological Society of London. London: Cassell, Petter, Galpin, and Co.

By way of introduction to the present work Mr. Swinton gives us a history of the causes which led to its being undertaken. The account of his entomological rambles gradually extending from Hampshire, Surrey, and Kent to France, Italy, and more distant regions, and of his researches into insect life, beginning with the capture and determination of British species, and thence passing to observations on the modifications of forms due to differences in food or in climate, has about it the true aroma of fields, the woodlands, and the mountains. To elder naturalists especially it will suggest pleasant memories of the past. He repeatedly laments the disappearance of many of the rarer and more beautiful butterflies from England—an extirpation due not so much to the mere spread of cultivation and enclosure as to the greed of dealers and their emissaries and to the mania for British specimens. He anticipates—not without reason—that in the future our insect hunters will be "doomed to a sport composed of an influx of Colorado beetles, white butterflies, Hessian flies, and woody oak-galls." He notices the strange fact how, with little difference of climate, the fauna of the northern coasts of France is so much richer and more diversified than that of Kent or Sussex. Have the species thus missing in Britain arrived in or been developed in France subsequent to the separation of the two countries, or have they since become extinct on the northern side of the Channel? Italy he considers has fewer attractions for the entomologist than for the artist and the antiquary. All the more attractive butterflies seem to keep to the Swiss pastures and the Sicilian high grounds,—the latter a locality where the traveller may be himself "collected" by brigands. "The bare-backed Apennines and fertile Maritime Alps are equally ignored by Italian savants; a few varieties of our northern favourites perchance grace Florentine gardens, and around Pisa you may just capture enough Diurni to convince yourself you are abroad." The following passage will give our readers a fair idea of the author's manner:—"The end of the

Blood Cicada was dire and classic. About the commencement of July there appeared as if by magic certain greyish insectivorous birds with a harsh and guttural note, among the sunny vines and the woody knolls where the Cicadæ had established their coteries, and these, sitting on the low brambles, sometimes two together, knavishly whistled a tune until an unwary songster was inveigled to respond, and so betray his hiding. The intruders then flew at him and brought him to the ground in their beak and claws, screaking most piteously *Whee! Whee!*"

The author, like ourselves, feels surprised that so many naturalists should be busied with the physiology of the Mollusca and lower forms of marine life "while we possess so little definite acquaintance with the life-history and structure of insects," and that entomology is still in the hands of the majority of its followers a mere matter of nomenclature. He very judiciously advises collectors before putting a specimen to death to note its specific odour, if any, and to observe whether it stridulates.

With the following passage we cannot entirely agree: speaking of bees, wasps, and ants he states "The very excellence of the acts performed by these unreasoning creatures is, as Dr. Carpenter has remarked, a proof of a non-intelligent nature." We have always suspected that the learned and voluble Doctor when penning these words must have been in a state of "unconscious cerebration." By the very same course of argument higher intelligences—and we are old-fashioned enough to believe that such exist—might demonstrate the non-intelligent nature of man. Nor can we admit Lamarck's definition of *Insecta* as mere sentient animals unable to combine the simple ideas which they derive from their sensations.

A little further we find the interesting generalisation that the Lepidoptera most conspicuous for beautiful colour are the most lethargic.

The section on the odoriferous, corrosive, and coloured principles secreted by insects is exceedingly valuable. Much further research is here evidently necessary, the chemical portion of which will be impeded by the difficulty of obtaining a sufficient quantity of the material for analysis. We read that the caterpillar of *P. Machaon* gives off a powerful odour of fennel. This fact is not surprising when, as is often the case, it feeds upon fennel, but is less readily understood when its food-plant is the carrot, or the caraway. The electric shocks, said on the authority of a writer in the *Magazine of Natural History*, to be given by the caterpillar of the puss-moth require confirmation.

In describing the scent-organs of butterflies Mr. Swinton gives the needful caution that these insects may occasionally absorb the odours of the flowers they have visited.

We must take exception to the author's remark that the Diptera are unarmed: witness the genera *Stomoxys* and above all *Erax*.

Mr. Swinton enters at considerable length into the question of the function of the antennæ in insects. He does not, however, refer to certain experiments which to us appear crucial. Insects when their antennæ were coated over with wax or varnish have been found utterly unaffected by fumes from which under all other circumstances they shrank back.

Many interesting cases are given of the recognition of colour by insects, and we find here a suggestive remark that the gradual extinction of species attendant upon the clearing of forests, drainage of swamps, and cultivation of heaths may be in some measure due to the removal of mimetic shelter. Mr. Swinton considers that browns, blacks, chlorophyll tints, and purple "are the pigments we notice on protected surfaces," whilst the hues specially designed to evoke the passions consists mainly in white and its prismatic elements. We have long considered bright and pure hues* as connected with the highest vitality. The author considers that the hind wings of a beetle are universally colourless. This is not absolutely correct. The posterior wings, *e.g.*, of the Colorado beetle are pink; those of *Lomaptera Urvillei* a beautiful violet blue; of *Belionota fallaciosa* a deep brown, of *Cotinis mutabilis* a greenish bronze on the anterior margin and of a blue shade on the posterior, the intermediate portion being of a reddish bronze. We have indeed noticed so many changes of decided colour in this part that we think the wings of every new or imperfectly known species should be carefully examined on capture.

Mr. Swinton raises further the very interesting question how the pattern is produced upon the wings of insects, especially butterflies. Does the secreted colouring matter "flow from the thorax through the tissues of the flaccid wings, and are the stains impressed by their membranous coverings in the manner of a printing press? In support of the latter hypothesis he mentions that a specimen of *Leucania conigera* captured near the Welsh Harp Tavern to the north of London in 1877 was found to have the markings upon the upper wings reproduced on the upper surface of the left lower; and a specimen of the common Meadow Brown taken near Oxford in 1878 showed the same transformation effected in the under surface of the same wings, accompanied with the development of an additional vein and consequent enlargement that seemed to afford a reason how the hind wing came to be folded so as to receive not alone the impress of the inferior side but the very eye-spot of the upper.

Neither of these hypotheses, however, is quite free from difficulties. We find in some cases, *e.g.*, *Apostrophia charitonia*, *Papilio Podalirius*, and many more which might be easily selected, the under surface merely a somewhat dulled and subdued reproduction of the upper. In such a case we might readily

* Journal of Science, 1878, p. 37.

conceive the design as produced by the transfusion or application of a colour either from the thorax or from the coverings of the wings. But in some cases we find the underside of the wings patternless, and in others marked with a design totally different from that of the upper. This especially holds good with the hind-wings. Thus in *V. Atalanta* the fore-wings exhibit the same general features on both surfaces, whilst the under surface of the hind-wing presents a design not reducible to that of the upper surface. Do not the colouring secretions enter the wing from within and become deposited on its upper and under surfaces according to laws still to be discovered?

On the local variation of insects—especially butterflies—the author has brought together a great mass of interesting and suggestive observations, a large portion of which is original. He describes the seasonable varieties, those due to climates, to latitude, altitude, the proximity of the sea, geological formation, the neighbourhood of towns, and the action of the unnatural atmospheres here often encountered. He quotes the remarkable fact that from a dark female *Trephrosia crepuscularia* the offspring in the first generation were one-half dark and one-half pale. In the second batch, the produce of dark parentage, they were dark in the ratio of two to one, and the third generation were all alike dark.

It is with regret that we must thus prematurely break off our examination of this work, valuable not merely as a good oversight of modern results in what may be called philosophic entomology, but as pointing out in what directions the student may usefully direct his labours.

The question may of course be raised whether a plainer and quieter style, with less of poetical quotations and classical allusions, would not have been more suitable to the subject. We find, too, numerous typographical errors, such as Vitis Graber, *passim* for Vitus Graber, anthropods for arthropods, *C. cantenulatus* for *C. catenulatus*, chloric for hydrochloric, *Calopterus* for *Caloptenus*, &c.

We cannot conclude without expressing our obligation to Mr. Swinton for the great pleasure we have derived from the perusal of his work.

Annual Report of the Smithsonian Institution, showing the Operations, Expenditure, and Condition of the Institution for the year 1878.

THE principal features of this volume include a biographical memoir of the illustrious physicist Joseph Henry, drawn up by

Prof. Asa Gray, with a catalogue of his published researches. Next follows a eulogy on Condorcet by Arago, and of course delivered a considerable time ago. A great portion of this discourse is far too political in its tendencies to be dealt with in our columns. We must mention, however, an interpolation of the works of Pascal, of which Condorcet has been accused. The passage runs: "Speaking according to the natural light of reason, if there is a God, He is infinitely incomprehensible, since having no beginning and no end He can have no connection with us. We are then capable of knowing neither what He is *nor if He is*." The last four words are not to be found in the older editions of Pascal's works, and Condorcet was therefore accused of a serious literary forgery. In 1803 Renouard even declared that "an obstinate search through the manuscripts of Pascal in the Royal Library had failed to discover the contested words." Nine years afterwards, however, he confessed that the words were really to be found on the fourth page of the manuscript exactly as they had been published by Condorcet, and they have further been discovered in an earlier edition of Pascal by Father Desmolets.

The volume also include a biography of Louis Agassiz, by E. Favre, written in a somewhat Cuvierian spirit. The author does not consider that his opposition to the doctrine of evolution resulted from prejudice.

There is an interesting paper by F. A. Ober on the ornithology of the Caribbee Islands. In this narrow region he obtained eighteen species and varieties of birds new to science. Mr. L. Kumlein contributes also a short note on explorations in Greenland.

Notice must also be taken of Mr. D. G. Elliot's "Classification and Synopsis of the Trochilidæ."

Flora of Plymouth. An Account of the Flowering Plants and Ferns found within twelve miles of the town; with Brief Sketches of the Topography, Geology, and Climate of the Area, and History of Local Botanical Investigation. By T. R. Archer Briggs, F.L.S. London: Van Voorst.

We have here a laudable, useful, and pleasant book, yet not without its painful side. Painful, we say, because, like every local flora and fauna in the United Kingdom—we fear it might even be said in the civilised world—it is a record of the gradual disappearance and approaching extirpation of harmless and beautiful species. The "ferny dells of Devon" have long been famous. But now, in a district comprising about one-ninth of

that beautiful county, some of the loviest species, such as *Polypodium phegopteris* and *P. dryopteris*, are now described as "rare and local," "very rare."

Concerning *Osmunda regalis*, the king of our British ferns, it is remarked:—"Considerably reduced in quantity through the plants being dug up and brought for sale to Plymouth and other large towns. All who value and wish to preserve the natural floral and vegetable beauties of the neighbourhood should do their utmost to prevent and discourage the selling in the streets of recently uprooted plants of the *Osmunda* and of our other ferns and wild plants." This caution is the more reasonable since many specimens are torn up at the wrong season of the year and so carelessly that they generally perish. It will become necessary for naturalists who find a good locality for any of our rarer and more conspicuous wild plants, and indeed insects likewise, not to make the matter public, since information intended for the botanist or the entomologist falls into the hands of dealers, who at once send their agents to make a clean sweep.

As regards flowers and ferns, the recent London practice of buying pot-plants in the spring, letting them perish in the winter, and getting a fresh stock the next year, tells disastrously upon every species that cannot be propagated as easily as the scarlet geranium.

The lily of the valley, one of the loveliest members of our native flora, is still met with in the Plymouth District, but is very rare. We know an instance of a country gentleman who had noticed with regret the gradual disappearance of this plant from his grounds, on coming up to London and taking a stroll through Covent Garden was offered for sale a quantity of roots fresh from his own park. His gardener and gamekeeper were in the pay of a dealer!

It is remarkable how easily beautiful species are extirpated whilst noxious and unsightly weeds gain ground in spite of all human diligence.

The author sometimes mentions interesting facts relating to animals. Thus we learn that an oil-beetle, *Meloe proscarabæus*, or in more modern nomenclature *Proscarabæus vulgaris*, feeds upon the acrid and poisonous *Arum maculatum*.

The account of the climate of the district is very interesting, The annual average temperature is higher by 2·56° than that of Greenwich. Spring frosts are, however, very frequent and destructive, and mild as are the usual winters ever and anon a severe season makes havoc among tender plants, the cultivation of which is never even attempted in the open air in most parts of England. The air is more uniformly moist and the sky more generally over-cast than in the more eastern parts of our island,—circumstances which cannot fail to leave their impress on the local vegetation.

Mr. Briggs's work bears the impress of thoroughness and

accuracy, and will prove the more valuable on account of that disappearance of species which we heartily join with him in regretting.

The book is illustrated with a map showing a division of the area into six sub-districts.

The Morals of Evolution. By M. J. SAVAGE. London: Trübner and Co.

A FEW thinkers are now venturing to trace the origin and the growth of that moral code which is, in theory at least, recognised by the civilised world. They are seeking to prove that our ethical system meets with a complete sanction in the very constitution of the world around us, with which, like every other product of Evolution, it must, by the very fact of its existence, be more or less completely in harmony. Such an undertaking meets with but little favour among the generality of so-called orthodox theologians. For this jealousy there is, we submit, no just cause. If certain moral doctrines have, as the majority of Europeans and Americans believe, been revealed to us by the same Being who created the universe, and if such Being is infinitely wise, we may fairly assume that they will be, not arbitrary and accidental, but in full accord with the nature of man and with the circumstances in which he is placed. Thoroughly knowing the latter we might infer the former. Hence if contributions to evolutionist ethics happen to be atheistic this feature is not essential. We do not see that either Theism or Christianity stands on a less firm footing if it be shown that an approximately complete system of moral laws might be developed by man from observation and experience, just as a very incomplete and fragmentary trace of such laws has been reached among certain of the lower animals. A theory is not considered to be compromised if we find that it can be arrived at by more than one independent procedure. Nor will religion be discredited if it can be shown that even in the supposed absence of a life to come good conduct is sure to be rewarded, and transgression to be punished. Whether any one has fully succeeded in furnishing such proof is of course an open question.

Mr. Savage undertakes to show that the moral significance of the doctrine of Evolution has been misapprehended; that it is "no hard and cruel force," but "the power and process by which, through the ages, the best is selected, preserved, and transmitted." It is, he contends, "of the very essence of Evolution to take account of Christianity." From this point of view

he attacks the burning question of the day "Is life worth living?" He considers morality and religion in the past, the origin and nature of goodness, the sense of obligation, the principles of selfishness and sacrifice, the relativity of duty, the real and conventional virtues and vices, the mutual bearings of morals and knowledge, moral sanctions, and the morality and religion of the future.

In dealing with such themes it would have been well if Mr. Savage had remembered that the position of the philosopher, like that of the poet, "should be higher than on the battlements of party." If we observe the men whom he refers to, the opinions which he cites, the instances of moral delusions which he selects, and note how he confers the proud title "a leading thinker of England," we must pronounce him one whose speculations lie to some extent outside of our jurisdiction. But we fear the elimination of the party element from philosophic works is becoming unfashionable. Were we not amazed lately to find one who has been looked on as the Aristotle of the 19th century using language only fit for professional agitators?

Mr. Savage protests with some force against a "misconception as to the moral significance of the doctrine of evolution." We may here remark that this misconception—if such it be—refers not to the doctine of Evolution *per se*, but to the hypothesis of natural selection as the principle to which such Evolution is alleged to be due. But this by side let us ask whether those forms of life which survive in the struggle for existence are the "best" in any worthy sense of the word? This struggle assumes two aspects according as it rages between members of one and the same species and between different species. In the former case it will doubtless be found that as a rule the strongest, most agile, bravest, and most intensely animated, will prove victorious. But will it not frequently happen that when the conflict is over the conqueror will have suffered so much injury that he will be inferior even to what the vanquished was at the outset? Hence the notion that *e.g.* the combat of two male animals for a female must necessarily lead to the perpetuation of the species by the more vigorous is not necessarily correct.

As regards the contests between different species we need only refer to the numerous facts which have appeared in the *Journal of Science* for years past proving that in the contests between different species, animal or vegetable, it is not the most beautiful, certainly not the most useful to man, or as far as we can judge, to the world at large, which wins the day. In organic creation, just as in the competition of daily life, or in international struggles, it is the *Nachbar-fresser*—the most persevering and unscrupulous destroyer of all neighbours—which triumphs.

To the author's query "would it have been any better if the weakest had won and the unfit had survived?" one sufficient

answer may be found in the letter of Nemo.* A further reply is that in many cases the triumph of the weaker, if it had been possible, would have been very much better. Suppose the place in creation now held by the rat were occupied by a species feebler, less courageous, less cunning, less prolific, would this not be an immense gain? The author says "if death is to exist at all it is difficult to see why it is any more cruel to have it come in this way than any other." But the charge against the "struggle for existence" is that it needlessly multiplies death. Nature calls a hundred species into existence, turns them into a spherewhere there is only room for ten, and bids them fight it out. Man puts in a given space only so many animals or plants as can there find room, and thus obtains far finer products. Much more might be said on this part of the subject did space allow showing that "Natural Selection" has little claim to the beneficent character with which the author invests it.

Mr. Savage tells us that as the ages pass "physical force is dethroned, and thought, first as cunning, afterwards as intelligence, sits on the throne." It will be some time before physical force is dethroned, or before thought in its higher manifestations wins in the struggle for life. "The nations discover," says our author, "in the stern school of experience, that the people which loves most is most closely bound together, developes most of tenderness, pity, charity, and mutual help; that this people wins, is mightiest, and so the fittest to survive." But what would be the fate of a nation which, like some of our modern English "advanced thinkers," had outgrown patriotism, and extended to all mankind alike that mutual help which others confine to their own countrymen? Just what would happen to any individual man who should open his table and his purse indiscriminately to all his neighbours whilst they rendered him no similar favours. Mr. Sydney Billing warns us that "A nation actuated alone by moral law, with conscience as a regulator or administrator, could not exist beside other nations impulsed by a lower ideal because it would be the prey of instinctive rapacity."†

As regards the discussion of the question "Is life worth living?" our author is scarcely fair. He writes:—"That the vast majority of men desire life—stay in instead of going out—turns the question as to whether it is worth living into an absurdity." To this argument it may be replied that men cling to life from hereditary instinct, from hope or curiosity as to what may befall them, from religious convictions, from a suspicion that it is safer to "bear the ills we have than fly to others that we know not of;" and, lastly, from a reluctance to abandon

* Journal of Science, Sept., 1880, p. 598.

† "Scientific Materialism and Ultimate Conceptions." *See* Journal of Science, 1879, p. 665.

children or others dependent upon them to the mercy of the world. Such, it may be urged, are the motives which restrain the millions from suicide. Granting that the majority of the evils under which we groan are remediable, the individual is powerless against them. We know that whether we struggle to remove them or not they will remain to torment our descendants. Nay, so far as can be judged from what has taken place within the last half century, there is room to fear that life is becoming harder, that the beautiful is growing rarer, and that man has less and less time and opportunity to think of truth and goodness. Evolution does not imply that the progressive changes taking place are necessarily towards perfection. We trace instances of degeneration in the structure of animals. There is no reason why a similar phenomenon may not occur in social or national life.

In the chapter, "Morality and Religion in the Past," the author argues that the two have not been necessarily connected, but that religions have often sanctioned and encouraged immorality, whilst "every grand onward movement of the religious life of the world has been started as a moral protest." He maintains that the origin of goodness is a much more important question than the origin of evil. Moral perfection, he thinks, is not a condition from which man has fallen, but one towards which he must gradually approximate. He believes that "the moral law stands by virtue of its own right, and would stand just the same without any regard to the question of immortality or the discussion between theism and atheism." He does not, however, raise the point brought forward by Mr. S. Tolver Preston that the "dogma of infinitely lasting punishment is practically tantamount to teaching that the pursuit of vice must be infinitely profitable in this life."* He accepts happiness as an end. He protests against the ascetic figment, that suffering is something meritorious in itself, and justly pronounces it "everywhere, and always evil, and only to be accepted for a larger and a higher good." He censures the churches for having taught that "if there was no God and no future life the way to be happy would be to break all the moral laws, and rush into every kind of evil." But whilst teaching that virtue entails its own reward, and is the way to happiness, he guards against the error of supposing that its reward will consist in the ordinary prizes after which men strive. "Do not find fault," he says, "with this universe because righteousness is not paid in greenbacks or government bonds."

Mr. Savage shows that there was a time when polygamy, slavery, despotism, were good in comparison with the conditions and practices which they had superseded. He recognises the fact that the philosophy of evolution has reconciled and explained

* Journal of Science, 1880, pp. 448 and 450.

the old conflict between those who uphold innate ideas, and those who derive all our knowledge from individual experience. And by the aid of heredity he accounts for the sense of obligation. He considers that man will not be perfected in virtue until he has reached a state where the feeling of duty, the consciousness of obligation, is left behind, and we do what is right with an instinctive spontaneity.

In treating on "morals and knowledge," the author states the "difference" of view between the educationist party and their opponents. Of the former he says:—"They point to the fact that the criminal class, in almost every civilised nation of the world, is recruited from the ranks of the ignorant." Now it is true that the criminal has no love of knowledge for its own sake. But if you force education upon him will his inherited nature be thereby modified? Again we read:—"They point to the fact that no one can dispute that those nations that are the most illiterate are the ones that present to us the longest catalogue of crimes." This alleged fact we consider by no means unimpeachable. It may be said on the authority of one who has had full opportunities of observing,* that among certain savage tribes each man scrupulously respects the rights of his fellow, and an infraction of these rights rarely or never takes place."

Mr. Savage insists strongly on the evils resulting from well-meaning ignorance. "The ignorant, stupid good nature of the world has been guilty of the larger part of its infamies." One term here requires emendation: for "good nature" let us read "conscientiousness."

Here space compels us to close our survey of this book. The bulk of its contents do not admit of discussion in our pages, and from many of its teachings we must emphatically dissent. But there can be no doubt that it is a work which thoughtful men will read with great interest and advantage.

The Natural History of the Agricultural Ant of Texas. A Monograph of the Habits, Architecture, and Structure of Pogonomyrmex Barbatus. By HENRY CHRISTOPHER McCOOK. Philadelphia and London: J. B. Lippincott and Co.

NEARLY twenty years have now passed since the first account of the Texan Agricultural Ant was given by the late Dr. Gideon Lincecum, of Long Point, and S. B. Buckley. The notes of these naturalists, however, were received with very general

* Mr. A. R. Wallace.

scepticism in America as well as in Europe. Dr. Auguste Forel, the well-known historian of the ants of Switzerland, remarks that Lincecum's observations inspired him with little confidence. The original papers of this eccentric entomologist fortunately fell into the hands of the Rev. Dr. McCook, and led to his visiting Texas in order to settle the doubtful points, and confirm, if possible, the observations of his predecessors. The result of this expedition is the interesting and valuable monograph now before us. The author took up his residence under canvas at Camp Kneass, about three miles from Austin, a region swarming with these ants, and devoted his entire time to the investigation of their habits and architecture. After his return to Philadelphia he continued his studies by means of artificial formicaries.

It is, in the first place, now thoroughly established, that the Agricultural Ant, and not a few other species in Australia, India, and the countries bordering upon the Mediterranean, do amass grain and other seeds during the summer, and employ them as provisions during the cold season. Thus by the labours of Col. Sykes, J. Traherne Moggeridge, Dr. Thomson, as well as of Dr. Lincecum, and our author, the credit of Solomon as an observer of animated nature* is re-established, and Latreille, Huber, Gould, Kirby, and other eminent observers, are proved to have been in error. But what was the mistake of these eminent entomologists? They were not inaccurate in their observations and experiments, but they were deceived by arguing from the ants of England and northern France, which are torpid during the winter, and require no food, to those of warmer climates. They forgot that what may be true for certain species, and under particular circumstances, does not necessarily hold good for other species and for the whole world. Hence, by the way, our author's remark in his preface, that from one species the reader may learn all, is to be taken with a grain of salt.

Dr. McCook has watched the agriculturals collecting seeds, carrying them for a considerable distance to their city and depositing them in underground granaries. Here they were stripped of their husks which were then carried out as refuse. The author submitted to the observation of qualified botanists parcels of seeds taken from the ants on their way home, others from the granaries, cleaned and uncleaned, and finally samples of the refuse. The seeds were found to be those of *Buchlæ dactyloides*, two species of *Panicum*, *Aristida stricta*, *A. oliganthia* (the grass supposed to be harvested in crops by the ant), besides seeds of a *Croton*, a *Paspalum*, a *Malvaceous* plant, and a *Polygonum*. The refuse contained not a single perfect seed, being made up of shells, glumes, and imperfect seeds.

But a further and yet more interesting question remains.

* Proverbs, vi., 6, 7, 8.

Lincecum maintained that *Aristida stricta* or *oligantha*--ant-rice as he named it—was actually planted, cultivated, and reaped by these insects. It is a biennial species which, he states, is sown in time for the autumnal rains to bring it up. "About the first of November, if the season is favourable, a green row of ant-rice, about four inches wide, is seen springing up on the pavement (*i.e.*, the clearing round the city) in a circle of fourteen or fifteen feet in circumference. In the vicinity of this row the ants do not permit a single spire of any other grass or weed to remain a day, but leave the Aristida untouched till it ripens, which occurs in June the next year. After the maturing and harvesting of the seed the dry stubble is cut away and removed from the pavement, which is thus left unencumbered until the ensuing autumn, when the same species of grass, and in the same circle, appears again and receives the same agricultural care as did the previous crop." Dr. Lincecum did not see the ants actually sowing the seed, but he asserts that there is no doubt "of the fact that this particular species of grass is intentionally planted."

Dr. McCook's observations on this point are to the following effect:—The *Arista*, ant-rice, or needle-grass as it is locally called in Texas, is the only plant ever found upon the clearing round an ant hill. No other vegetation is tolerated, and the position of a formicary is visible from a distance by the belt of needle-grass surrounding it. But it is not universally present. In many cases the clearing around the city was entirely bare. Nor could the author detect any reason for this difference. As far as the evidence goes he concludes that the ants find it to their advantage to permit the *Aristida* to grow upon their discs whilst they root out all other herbage. The crop may be re-sown in a natural way by droppings from last year's plants, or by seeds lost by the ants on their way home. Still he does not venture to pronounce that there is anything "unreasonable or beyond the probable capacity of the emmet intellect in the supposition that the crop is actually sown." The proof is wanting. The Texan ant has never been observed by the author gathering or plucking seeds from the plant, it merely picks up such as have fallen to the ground. Another species found in Florida and Georgia—*Pogonomyrmex crudelis*—has been seen by Mrs. Treat as well as by the author cutting seeds from plants.

As regards the nests of the Agricultural Ant Mr. McCook recognises and describes six distinct types. He can detect no difference in the structure of the ants taken from these different kinds of nests. As far as his inquiries have gone it seems that cities of these different kinds are not promiscuously intermixed, but that those of similar structure are found near each other.

Concerning the co-operation of ants at work the author makes some important observations. He says:—"Another ant comes to the help of the first, a third soon follows, and before the gal-

lery is sunken very far a fourth and a fifth join in the digging. There has been no communication that I can observe to secure this assistance, nothing like a call to her comrades by the original worker, nor by any of her successors. Her movement, if I may so speak, is contagious. Her excitement has been communicated by some imperceptible bond of sympathy to others of the colony who have joined her in the work, as if urged by some uncontrollable instinct. The excitement, however, has not captured all the little community. I believe that the digging is conducted by relays. The excitement which carries individuals into the trenches seizes all in turn, is intermitted and repeated as long as there is any necessity or opportunity for exertion."

It is evident that the industry of the working ants cannot be traced to the two causes which, according to some authors, underlie all animal activity, *viz.*, hunger and the sexual appetite.

Mr. McCook notices that ants—differing in this respect from our domestic vertebrates—never quarrel over their supply of food. There is none of the selfishness and bullying which is always witnessed when poultry, swine, or cows, are being fed.

As regards the intelligence of these ants the following statements are not without value. A young farm labourer informed Mr. McCook that his employer had tried to poison the Agriculturals. Arsenic spread upon bread was put in their way. This killed those that partook of it, but they soon abandoned the bread. The arsenic was then mixed with meal and put into their nests, but they separated the poison and carried away the meal. It was then mixed with treacle, but here again, after a few had been poisoned, the bait was left untouched.

It is further established beyond doubt that ants have funeral regulations. "All species whose manners I have closely observed are quite alike in their mode of caring for their own dead, and for the dry carcasses of aliens. The former they appear to treat with some degree of reverence, at least to the extent of giving them a sort of sepulture without feeding upon them. The latter, after having exhausted the juices of the body, they usually deposit together in some spot removed from the nest.

According to Mrs. Treat, *Formica sanguinea*, a slave holding species, never buries its own dead along with those of the slaves, *Formica fusca*.

The Agricultural Ant is described as not wantonly aggressive, unlike, *e.g.*, the fire-ants of Aveyros, of which Mr. Bates has given such a graphic account. Their sting, however, when inflicted, is very severe. The first symptom is a sharp pain resembling the sting of a bee. "Then followed twice, at short intervals, a nervous chilling sensation which seemed to sweep upwards, and was felt quite sensibly around the roots of the hair. Then followed a steady, heavy pain, about the wound, which continued from three hours more or less severely, a slight

numbness accompanying, but no inconvenience thereafter." Ammonia and dilute tincture of iodine are used as remedies.

We must here, however, bring our examination of this admirable monograph to a close. No naturalist, we are convinced, can read it without great pleasure, full as it is of the most interesting and carefully-conducted observations.

Life and Mind, or the Basis of Modern Medicine. By Robert Lewins, M.D. Edited by "Thalassoplektos." London; Watts and Co.

We have here a small, but most remarkable book, noteworthy not so much for the doctrines it contains as for the outspoken manner in which they are asserted. We cannot better expound these views than by quoting some of the "ten theses" in which they are summarised by the author:—

"3rd. Natural Science is bound in conscience to divulge *all* her results, however much they may conflict with contemporary prejudices in order to satisfy the human mind and leave it free for the further pursuit and enjoyment of truth. Mental reservation, prevarication, and *suppressio veri*,—even from such respectable motives as Mr. Darwin confesses, in his 'Descent of Man,' to have influenced him for many years,—as habitually practised by contemporary English thinkers and *savans*, is disloyalty to humanity and reason, ruinous alike to their country and to the cause of civilisation and rational liberty throughout the world.

"4th. Natural Philosophy for 190 years past has rendered trite the axiom that everything in the universe proceeds by unalterable law—an axiom thoroughly fatal to any form of religion.

"5th. The world is from eternity to eternity. Nothing is ever created, nothing lost. Beginning or ending there is alike none. Only the form and condition of things is perishable. *Everything that exists dates from eternity. Ex nihilo nihil fit.*

"6th. The universe is boundless in space and time. Matter *can* have no limits, eternity in time and immensity in space being correlative.

"7th. As the logical inference from the above, millions and millions of millennia are before us, in which worlds and systems of worlds shall flourish and decay; at their lapse the universe *can* be no nearer its dissolution than at the present or any former period.

"8th. The so-called 'Personal God' is merely an idol of the human brain—a pseudo-organism of pre-scientific man endowed with man's attributes and passions, a remnant of Fetichism or Animism. . . Absolute Atheism is, however, no postulate of Science which does not venture to impugn the evidence of

Cosmical Design, or the existence of an unknown, inconceivable, intelligent 'First Cause' (the phrase is a misnomer), of whose Eternal Mind the Eternal Universe *may* be an hypostasis or emanation."

To examine all these theses, or even those we have quoted, would manifestly require far more space than is at our disposal; but we may briefly direct our attention to the fifth, in which the eternity of the universe is plainly asserted. But as far as man has been able to penetrate into the mysteries with which he is surrounded, all natural forces tend to an equilibrium, which when reached all life, all activity, all motion must come to an end. Our planets must gradually become dried up like the moon, and will doubtless fall into the sun. The sun, which in the opinion of the ablest authorities has "seen his best days," must—in spite of this additional fuel and of the heat engendered by the conversion of mechanical motion—burn himself out. Even the falling of suns into each other cannot prevent the end for ever. There may, indeed, be a recuperative process at work in the universe tending to counteract all this levelling process; but we have no physical evidence of its existence, and cannot even conceive its nature. Dr. Lewins, be it noted, does not venture to deny the possible existence of an Eternal Mind. Why, then, should he venture to deny finite minds, without which it is extremely difficult to give an account of many familiar phenomena. It will be perceived that there is in this work not the slightest attempt to show how physical energy is transformed into life, or how atoms of carbon, oxygen, &c., come to feel an interest in the position in which they are arranged.

The Appendix, from the pen of "Thalassoplektos," is an exposition of the treatise of Dr. Lewins, and contains much of which we can approve and no little against which we must protest. He condemns, very justly, our competitive examinations, but he does not honour the man of research and the specialist. What, for instance, must we think of such passages as the following:—"With such men as these [*i.e.*, country squires, cavalry officers in regiments rarely selected for foreign service, &c.] *savans* and literati cannot for a moment compare. The highest life, as compared with the narrow *epicier*-like existence of the specialist, despite his assumption, wherever possible of ill-sustained superiority, is that of the country gentleman, the dignified clergyman, and that of the well-fed contented peasant!"

Again:—"*Savans* may pile discovery upon discovery, until, as was the case with Michael Faraday, the desire to discover becomes a real mania; but the life that is wholly given over to such pursuits is a mis-spent one, and is, as an example, positively injurious to society. The whole burden of 'Faust' is to trace the gradual development of a superior mind, a perfect man, from contemplative to active pursuits, from the library, laboratory, museum, and observatory, and finally to the execution of

colossal works of engineering. In truth the perfect man is not given to dreaming or to unduly exercising any one portion of his nature. *Savans*, such as Faraday, who pedant-like stick throughout their whole lives to contemplative pursuits, are, as we have often asserted, inferior natures, like the famulus Wagner of Goethe's great tragedy!"

Surely the writer forgets that his supposed "perfect man," in forsaking Science, is under the especial guidance of the Evil One, and that the "active pursuits" beginning with seduction and murder go on to finance operations, whilst the "colossal works of engineering" are executed at the cost of expropriation and bloodshed, as we see in real life.

Goethe makes his Fiend give the student this advice:—

"Verachte nur Vernunft und Wissenschaft
Des Menschen allerhöchste Kraft!"

Thalassoplektos accepts this as *bona fide*, and would have us take Mephistopheles at his word!

We do not see that Science has anything to gain or to learn from this work. Nay, we fear that its spirit must be regarded as decidedly anti-scientific, and as a verification of the forebodings expressed from time to time in this Journal,—to wit, that *savans* may in future experience ill-will, and even persecution, not from ecclesiastics, but from the champions of "free thought."

We may well ask, who is "Thalassoplektos" that he should dare to pronounce Faraday an "inferior nature," and consider his life less perfect than that of such nonentities as country gentlemen and idle cavalry officers? Might he not have gone a little step further in the same direction, and pronounced the career of a gorilla a still closer approach to perfection? There is, further, nothing "dreamy," "contemplative," or "pedantic" in the scientific nature.

Into the religious bearings of this work we do not feel it within our province to enter; but we would ask whether Pessimism is likely to be abated if we learn that there is no "land of the leal" where the weary may hope for rest?

Both Dr. Lewins and "Thalassoplektos" predict the approaching downfall of England. Their prophecies may possibly be verified, but if so the crisis will be due not to the survival of the religious element among us, but to the decay of the "tribal instinct."

Several important books stand over for review, on account of the want of space.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

"THE DISESTABLISHMENT OF THE SUN."

To the Editor of The Journal of Science.

SIR,—Referring to the work bearing the above title, noticed in your August number, it seems to me that neither the author nor your reviewer has given full weight to one fact. The former argues that if the poles are cold because the sun's rays fall upon them obliquely, a spot on the equator at midnight ought to be colder still, because it is out of the sun's rays altogether. To this erroneous conclusion your reviewer merely replies:—"He forgets that at the poles the sun's rays are absent for one-half the year entirely, and fall during the other half obliquely and scantily upon the soil; whereas at the equator the surface of the soil has not time to cool down during a single night." This is all very well; but both you and the author overlook the fact that in places in the torrid zone where vegetation is wanting, and the absence of watery vapour in the air gives full scope to the loss of heat by radiation,—*e.g.*, in the Sahara, and in many parts of South Africa,—the cold in the night is very severe. There can be no doubt that if the return of the sun could be delayed but for a few hours, frost would be experienced in all arid regions within the tropics. I do not see how these night-chills can be explained on the author's theory.

As regards his assertion that glass is impervious to heat, how can he explain the arrangement adopted at all meteorological observatories? The maximum temperature of solar radiation is observed by means of a thermometer placed horizontally on a wooden frame 5 feet from the ground, whose bulb is made of black glass, externally covered with fine lampblack, and enclosed in an outer and exhausted tube of transparent glass. This arrangement has been selected not on theoretical principles, but in accordance with experiment. The author does not remember the different behaviour of glass with radiant heat according as it is emitted from incandescent or non-incandescent bodies. The

heat of a pipe conveying warm water or steam, of a hot-bed, &c., is to a great extent retained by a glass covering. Of the radiant heat from an Argand lamp 92·3 per cent passes through a plate of rock-salt, and 67 per cent through a plate of flint-glass. The higher is the heat of the source of the rays, the larger proportion is transmitted.—I am, &c.,

PHYSICUS.

NOTES.

The Benefits of Vivisection.—The "Popular Science Monthly" gives a neat summary of Dr. Charles Richet's arguments in defence of vivisection. He demands that it shall be judged by its practical results, and claims that if it can be shown that we have gained by this method of experiment the means of curing one or two diseases of man it must be considered legitimate. He cites a number of discoveries made through vivisection. Among them is the discovery of the circulation of the blood. "Galen established the fact that the arteries contained blood by observations in the artery of a living animal; Harvey opened the chests of living animals, cut into the pericardium, observed the contraction of the heart, and what was going on in the veins and arteries, and deduced from what he saw his theory of the circulation. Transfusion of blood, an operation resorted to in extreme cases with the best results in saving life, was introduced after its possibility had been ascertained from experiments upon animals first made in 1664 by Lower, and afterwards by Denis. 'Experiment alone,' Dr. Richet says, 'will teach us precisely what quantity of blood is necessary and what is harmful; and if over-sensitiveness forbids animal suffering for this end, then the experiments would have to be made on human beings.' The mode of death from the inhalation of carbonic oxide, and correlatively, the method of avoiding or preventing death from inhalation, have been made known only through vivisection. So also 'all that we know in hygiene of the quantity of air necessary to support life is the result of experiments on dogs and rabbits. Sometimes a precise knowledge of the conditions of respiration has served to prevent men from perishing.' Only two methods exist by which we may learn the conditions of gastric digestion and collect its secretion, viz., by observation of gastric fistulæ produced by chance in man, and by artificial fistulæ in animals. The first method has been possible only in three or four instances, but the effect of food on the gastric secretion in dogs and cats has been largely observed; and the knowledge of the remedies which have been applied to the relief of dyspepsia has been derived from such studies. Our knowledge of nutrition has been largely added to by means of experiments in which dogs and cats have been submitted to varied alimentation, and from which the quantity and quality of food necessary to sustain life have been deduced. What we know of the nerves has been gained from studies of animals, as have also the means of relieving neuralgias and paralysis, in which, thanks

to the scientific analyses of the vivisectors Fritsche, Hitzig, and Ferrier, 'we can pass from the effect to the cause, and assign to paralysis a central lesion at a well-determined spot, so that trephining at this spot may cause the paralysis to disappear.' The experiments of Galvani and his followers on frogs have taught us to estimate the effect of the electric current on nerve and muscle, and shown us how to apply galvanisation to the prevention of the paralysis which ensues from the destruction of the motor nerves. The numerous patients relieved of nervous diseases 'by this admirable therapeutic agent have no call to speak ill of such vivisectors as Galvani, Aldini, Volta, Magendie, Marshall Hall, Remak, Du Bois Reymond, and many others, since it is to their discoveries that the relief of their ills is owing. Would Galvani have made his discoveries had he refrained from dissecting frogs? Would the electric current have been applied to atrophied limbs if it had not been found that the action of this current in dogs was salutary and not dangerous?' Certain diseases of the urinary organs have been studied in animals. The treatment of sympathetic ophthalmia by section of the ciliary nerves of the diseased side has been shown to be advantageous by experiment, and the results yielded by experiments on dogs and rabbits have been applied to patients. The correct treatment of cataract has been similarly learned. Encouraging progress is made by vivisecttion in the study of the formation of callus, of pseudarthrosis, of osseous grafts, of regeneration of bone by periosteum,—subjects of great importance in surgery. The vaso-motor theory, which plays a large part in the medicine and surgery of the present day, has been established by experiments on the great sympathetic and the rabbit's ear. Dr. Brown-Séquard has furnished useful ideas relating to epilepsy and tetanus from the results of painful experiments on dogs and guinea-pigs. Trial on animals is useful to determine the action of new medicines, for 'we do not wish to experiment on man at the risk of poisoning him, where animals can be employed,"—so with poisons. Finally, if we deprive *savants* of the right to submit living animals to experiment, we shall go back beyond the days of Galen. 'If all those who have been relieved—verily made to live again,'—says Dr. Richet, 'by modern medicine and surgery, could speak, they would confound those who load vivisection with calumny, and they would hold that their own life and sufferings weighed more in the balance than the sufferings of those animals which have been sacrificed in laboratories to the lasting benefit of man.' "

Anti-Vivisection.—"We observe that a memorial recently presented to Mr. Gladstone, urging him to do all in his power for the absolute abolition of vivisection, was signed by 'one hundred representative men;' among them Cardinal Manning, Prince Lucien Bonaparte, Alfred Tennyson, Robert Browning, James Anthony Froude, John Ruskin; the head-masters of Rugby,

Harrow, and seven other large schools; twenty-one physicians and surgeons; and thirty-seven peers, bishops, and members of parliament. The memorialists take the ground that vivisection, even with anæsthetics, should by law no longer be allowed, and they quote the opinions of Sir William Fergusson, Sir Charles Bell, and Mr. Syme, that 'it has been of no use at all, and has led to error as often as truth.' They add that the utility, if proved, would not, in this case, excuse the immorality of the practice. Of the persons herein named as being in favour of total abolition of vivisection, Sir William Fergusson and Mr. Syme may be accepted as competent to express an opinion with as much authority as belongs to eminent surgeons of the past age, which believed in nothing new and practised rule of thumb. Of the remaining 'one hundred representative men' probably not one knows anything whatever of the practices which he seeks to abolish, or of the results of those practices. Most of them are essentially 'emotionalists' who would sign any earthly manifesto on a humanitarian subject if only their bowels of compassion were sufficiently harrowed up by the falsehoods of which we know by experience that anti-vivisection agitators are capable. They are all either professed philanthropists and religionists whose signatures to such a document are a matter of course, or else they are well-intentioned people who are simply bored into signing without inquiry or serious thought. As for the 'twenty-one physicians and surgeons' we covet further information. We should like to analyse the list to ascertain how many of them are simply traders on gushing philanthropy as a means of advertisement or of fee-getting; or how many of them are of the fossil *laudator temporis acti* class, who are still sceptical as to germ-theories, septicæmia, and evolution, and who believe in bleeding for a cold in the head. We wish the anti-vivisectors would offer us the name of even one single modern physician or surgeon of repute for learning and research who will go for total abolition of vivisection. One such signature would be worth the whole hundred of peers, members of parliament, poets, and schoolmasters, or of any number of the class of doctrinarians who are in the habit of making up their minds without thinking and uttering manifestoes without learning."—*Medical Press and Circular.*

M. Lortet describes in the "Comptes Rendus" (Sept. 13, 1880) the dredgings which he has undertaken in the Lake of Tiberias. This body of water has once been salt, and is still slightly brackish. The fauna holds an intermediate rank between those of fresh and of salt waters. Algæ and Confervæ were entirely absent.

M. P. Hautefeuille communicates to the Academy of Sciences the observation that ozone at a high tension appears of a beautiful blue colour, which deepens as the pressure increases.

The "Journal of the American Chemical Society" contains a biographical notice of the late M. Tessié du Motay. It appears that he was not merely eminent as a chemist and a technologist, but had earned some reputation as a poet, a dramatist, a musician, and a student of Oriental literature and mythology. He leaves behind him an unpublished poem entitled the "Expiation of Faust."

A morning paper favours its readers with the following choice tit-bit of un-natural history:—"The only good thing to be said for the shark is that it knows its own friends, and studiously abstains from eating the pilot-fish, which guides it to its prey. It spares this useful little attendant, as the crocodile spares the humming-bird or the trochilus." The writer might find it difficult to show what opportunities the crocodile has for sparing the humming-bird, or how the latter can ever be of use to him.

Another writer, in the self-same paper, speaks of the hamster and the marmot as identical!

M. Th. Lécard has communicated to the Academy of Sciences an account of a vine with tuberous roots and a herbaceous stem, which he has discovered in Soudan. It yields abundant and delicious grapes.

Dr. B. W. Richardson, in a paper read before the Sanitary Institute (Exeter, Sept. 20th, 1880), seems to approach the position of Prof. Jäger. He writes:—"Go into the wards of a lunatic asylum, and notice among the most troubled there the odour of the gases and the vapours they emit by the skin and the breath. That odour is from their internal atmosphere, their nervous ethereal emanation. They are mad up to suicide or murder, or any criminal folly. Can it be otherwise? They have secreted the madness; they are filled with it; it exhales from them. Catch it, condense it, imbibe it, and in like manner it would madden any one." Is not this the teaching of Jäger and Dunstmaier, spiced to suit the audience and the occasion?

The "Medical Press and Circular" learns with delight—which we fully share—that "Dr." Tanner's lecture on his forty days' fast, given in Booth's Theatre, New York, "did not draw an audience capable of half filling the house.'

According to the "Zeitschrift für Physiologische Chemie" (iv., p. 382) G. Hüfner has obtained from putrescent blood long purple-red crystals of hæmoglobine, often above a millimetre in length.

M. E. Yung ("Comptes Rendus," August 30, 1880) has studied the development of the eggs of *Loligo vulgaris* and *Sepia officinalis* exposed to light of different colours. The development is hastened by violet and blue light; retarded by green and red. Yellow light behaves like white light. Larvæ of *Ciona intestinalis* also grew most rapidly in the violet light. Development

under the red and green lights, though retarded, was effected in perfection.

We learn that the Rev. W. H. Dallinger, of Liverpool, the distinguished microscopist, has accepted the appointment of Governor and Professor of Biology at Wesley College, Sheffield. This institution may be congratulated on the acquisition it has made.

We learn with regret that the robin-redbreast is eaten in Loraine in such numbers that they are becoming scarce. What is still worse, we hear that a certain French provincial *prefet* has given orders for the destruction of swallows and martins as injurious!

One George Aldersbury, an imitator of Dr. Tanner, has succumbed to the system of fasting which he had attempted.

According to the Berlin "Klinisches Wochenblatt" hæmoglobinuria may be caused by inhaling hydrogen arsenide, even in small proportions,—*e.g.*, hydrogen gas prepared with sulphuric acid and zinc contaminated with arsenic, as is often the case.

The "Medical Press and Circular" states that Mr. Malcolm Morris, Honorary Secretary of the London Medical Society, is issuing circulars requesting Fellows of the Society who have seen cases of arsenical poisoning by means of wall-papers to forward particulars to him at 63, Montague Square.

A paper "On the Function of Aperture in Microscopic Vision," by Prof. Abbé, of Jena, has come before the Royal Microscopical Society. As the paper would occupy about 150 pages of the Journal, the Council have decided to print it as a separate volume.

Dr. H. Stolterforth, M.A., in a communication to the Quekett Club recommends boiling in soap and water as a means of cleaning Diatomaceous materials, in all cases where it is available, in preference to the ordinary mode of treatment with acids and strong alkaline solutions. He considers it far less liable to do mischief to the delicate organic structures under treatment than the ordinary methods.

In a paper read before the Royal Microscopical Society, Mr. J. W. Stephenson demonstrated that the visibility of minute objects depended upon the difference between the refractive index of the medium in which they were viewed and that of the objects themselves, and, further, that it was useless to employ objectives of the large apertures now attainable unless the objects were mounted in media capable of utilising the whole of large pencil; by using them on objects mounted in air their effectiveness is reduced to the common level of $180°=1·0$ numerical aperture. The following table of indices is given:—

Air	equal	1·00
Water	„	1·33
Diatomaceous silex ... ... } Sulphuric acid ... ... }	„	1·43
Canada balsam	„	1·54
Bisulphide carbon	„	1·68
Solution of sulphur in bisulphide carbon (approximately)...	„	1·75
Sulphur...	„	2·11
Solution of phosphorus in bisulphide carbon (approximately)	„	2·10

Taking the difference between the refractive indices of Diatomaceous silex and the several mounting media, the following results are obtained:

Water	10
Canada balsam	11
Bisulphide carbon	25
Solution of sulphur in bisulphide carbon ...	32
Solution of phosphorus in bisulphide carbon	67

The practical result of the investigation appears to be—

That it is essential, if the whole aperture of an objective is to be utilised, to mount minute structures in some medium other than air.

That although the full aperture and revolving power are secured by mounting in balsam, it gives nevertheless nearly the faintest image of all.

That a solution of phosphorus is, as far as visibility is concerned, by far the most effective, but the difficulties attending its use must render it unpopular.

The next best is a solution of sulphur in bisulphide of carbon (although pure bisulphide is very good), and with these there is no technical difficulty whatever. This medium can easily be secured by using the solution employed by Mr. Browning in making his bisulphide prisms. A ring being made on the slide, and a drop of the sulphur solution or pure bisulphide being placed in its centre, nothing is necessary but to place over it the thin cover with its adhering diatoms, press it down on the still moist ring, running round it a somewhat copious margin of the cement. When dry, to protect it from the water of the ordinary immersion lenses, it is desirable to give it a coat of gold-size or shellac varnish.

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